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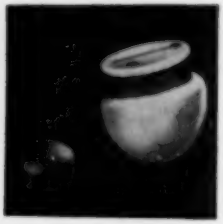

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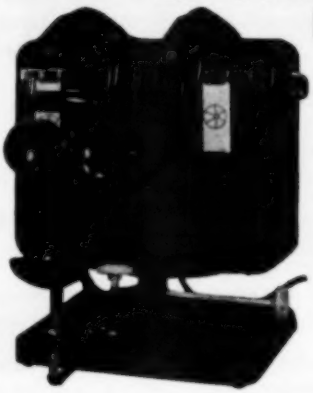

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As an example of one method of solving this problem, we have the case of Mrs. H. who required a small distance correction with a +1.50 add for reading. Mrs. H. had no trouble with her bifocals on the street or for reading. It was only when cooking, ironing or washing dishes that she found them unsatisfactory.

The problem was solved to the patient's complete satisfaction by giving her minus add fitovers. These fitovers were made plano in the distance portions and with −0.50 add segments.

The patient was instructed to use the fitovers only when doing house work and to take them off for reading or sewing. She reported, after trying them for several weeks, that in addition to being fine for housework, the fitovers were a big help while playing the piano. She adjusted the music rack slightly farther away and used the distance portion to read the music. The bifocal portion with the aid of the minus add fitovers was focused perfectly for the piano keys.

Minus add fitovers can be used to help quite a wide variety of bifocal wearers. Stenographers, printers, musicians and switchboard operators are often helped by them. In the case of the switchboard operators, it is sometimes necessary to have the upper part a +0.50 sphere and the bifocal a −1.00 add.

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ABSTRACTS

Anatomy, embryology, and comparative ophthalmology; General pathology, bacteriology, immunology; Vegetative physiology, biochemistry, pharmacology, toxicology; Physiologic optics, refraction, color vision; Diagnosis and therapy; Ocular motility; Conjunctiva, cornea, sclera; Glaucoma and ocular tension; Crystalline lens; Retina and vitreous; Optic nerve and chiasm; Neuro-ophthalmology; Eyeball, orbit, sinuses; Eyelids, lacrimal apparatus; Tumors, Systemic disease and parasites; Congenital deformities, heredity; Hygiene, sociology, education, and history 641

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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 33 APRIL, 1950 NUMBER 4

TRAINING METHODS AND AIDS IN THE TEACHING OF OPHTHALMOLOGY

VICTOR A. BYRNES, M.D.
Randolph Field, Texas

Medical educational institutions have been very slow to adopt the advances made in recent years in teaching methods and improvements in training aids. In the teaching of ophthalmology it has often been assumed that if an instructor has a national reputation as a clinical ophthalmologist, he is, per se, a good instructor. If a room with a blackboard is provided, that is considered to be all that is necessary in the nature of facilities for undergraduate instruction. Any shortcomings in the instruction, facilities, or equipment are supposed to be compensated by the eagerness of the medical student for knowledge. This eagerness is supposed to induce him to sit up all hours of the night looking up points inadequately covered in lectures. The fact is, however, that this is not the usual occurrence and the students of some outstanding ophthalmologists know less ophthalmology than students of some less known men who are good teachers.

Since the aim of instruction is to give the student the maximum amount of useful knowledge, it behooves teaching departments to take advantage of modern methods. These methods require considerable planning of presentations with construction of training aids and even rehearsal of presentations. They do not permit the, "Let's see, what are we discussing today?" opening remark.

Teaching principles apply equally to undergraduate and graduate teaching of ophthalmology. The undergraduate has less complicated material, but he also has less motivation. The graduate student has excellent motivation, but is attempting to assimilate a tremendous mass of information and the better it is presented to him, the more of it he can grasp and retain.

Successful didactic teaching of ophthalmology depends upon a number of basic factors including: (1) Accurate, properly organized, well-prepared material; (2) presentation by an instructor who not only is thoroughly conversant with the subject, but who also has the ability to teach it to others; (3) a classroom so designed that all students can hear the presentation and see the demonstrations, (it must be equipped to permit proper use of training aids); (4) adequate training aids.

ORGANIZATION OF MATERIAL

Material presented should be scaled down to the amount which can be properly covered in the time allotted. Giving long lists of names of conditions which cannot be discussed only serves to confuse the student and give him a feeling of inadequacy. Each presentation, whether lecture, conference, or clinic, should have a definite objective which should be stated at the beginning, together with an outline of the material to be covered. Items should be presented in logical sequence with explanation of why they occur if that is known. A concise summary of the presentation should be made at the end emphasizing the important points and what the student should know as a result of the conference.

Presentation

Unless an instructor has demonstrated his ability as a teacher, he should devote time to perfecting his delivery. A course in teaching technique and public speaking should be a part of every large teaching institution and instructors should be required to attend.

Classroom design

The facilities available in a classroom are important. The following features are believed essential (fig. 1):

1. A platform so arranged that all students can clearly see the instructor and all demonstrations.

2. A platform large enough so that all desired tridimensional models can be placed on it.

3. If classes are large, a loud-speaker system so all students can hear without effort. If used, a nondirectional or a lapel microphone should be used so the instructor can move freely about the platform and still be heard over the loud speaker.

4. Air conditioning or other ventilating system so the windows may be kept closed at all times. This permits instantaneous change from light to dark room for projection of movies and slides.

5. Adequate illumination with all lights on a single switch controlled by the speaker or projectionist so there is no confusion when darkening the room.

6. A projection booth at the back of the room and projection screen always in place to eliminate confusion incident to the showing of movies, slides, or film strips.

7. A silent push-button signal system from speaker to projectionist for the changing of slides to eliminate "the next slide, please" presentation.

8. Presence of 6 or 8 sliding panels which can be quickly pulled into view and as quickly pushed from sight. These panels display large charts, the advantages of which are detailed under training aids.

9. The presence of a blackboard, the use of which is discouraged in favor of better training aids in nearly all instances.

10. Chairs as comfortable as can be provided and with facilities for students to take notes.

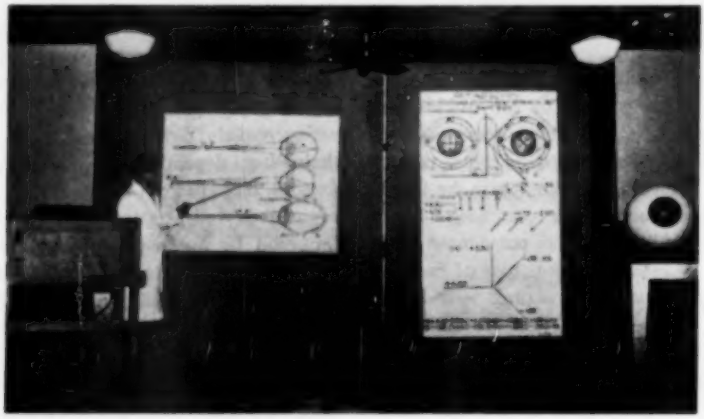

Fig. 1 (Byrnes). Type of classroom facilities needed. An elevated platform, large enough to hold tridimensional training aids, a lecturn equipped with amplifier, projectionist's signal button and shielded light which does not interfere with projection of slides or movies. Eight sliding panels which can be pushed out of sight are available, two of which have a blackboard facing. Behind the panels is a projection screen constantly in place; hence undamaged and unwrinkled.

Types of training aids

The maximum practicable number of training aids which increase the student's understanding and knowledge should be used. These audiovisual aids may be printed material, drawings and charts, photographic materials, or tridimensional models. They assist in the explanation and help to fix concepts in the mind of the student.

Printed aids

Printed materials may consist of text material for reference by the student, mimeographed handouts for additional reading, or what has been found very useful, a mimeographed lecture outline which contains the main topics or headings and upon which sufficient space is left for the student to fill in notes on the bulk of material presented. This latter aid is useful in giving the student a good outline without the soporific effect produced by a completely transcribed copy of the presentation. Enough student participation is required in taking notes to insure attention without requiring so much writing that the mechanics of recording the material outweighs the mental effort applied to understanding it.

Photographic aids

Photographic aids may consist of: (1) Photographs or transparencies of cases, materials, or equipment; (2) 35-mm. film strips for illustration of lectures; (3) 2 by 2 inch or 3 by 4 inch slides for projection; (4) silent or sound movies.

Photographs of diseases or techniques may be distributed for individual study during the presentation or may be mounted in clinics or examining rooms where students may refer to them later—(fig. 2). Three-dimensional photographs up to 8 by 10 inches in size can be made in lenticulated screen transparencies and may be useful where the impression of depth is important in understanding a concept.

Thirty-five millimeter film strips are an excellent means of illustrating a lecture. If made in color, they are especially effective. Instead of using individual slides, the film is advanced one frame for each illustration. It has the disadvantage that the order of presentation of material cannot be readily changed once the strip has been prepared. It shares with other projected aids the disadvantage that the room must be darkened for its effective use.

This darkening of the room tends to make

Fig. 2 (Byrnes). The 35-mm. Kodachrome transparencies may be mounted so they can be studied at leisure by students. A large strong plus lens on plastic-tipped legs aids in viewing the transparencies and gives them an apparent depth not present when viewed without the magnifying lens. Large, framed photos are also useful aids.

the sleepy individual even sleepier and tends to lose for the instructor the contact he has with the student when he can look him directly in the eye. This disadvantage can be partially overcome by a presentation requiring the lights to be out only a part of the time so that sudden transition from light to darkness and vice versa is frequently made. Classroom facilities for control of lights and projectors are important in this connection.

Slides, either 2 by 2 or 3 by 4, are valuable, commonly used aids. Judicious use of color for emphasis increases their effectiveness. Here, too, the presentation should be so arranged that lights remain turned off for only short periods.

Movies, especially those demonstrating

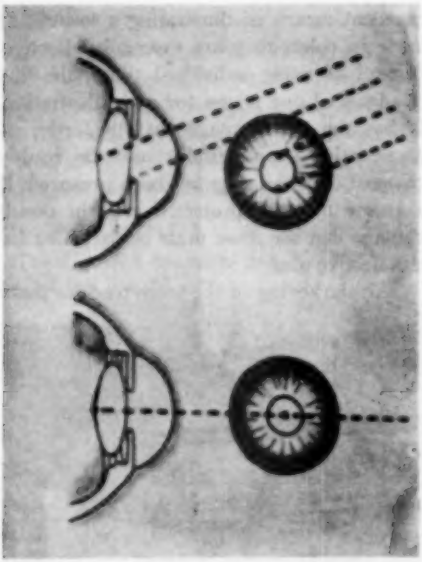

Fig. 3 (Byrnes). Large charts on sliding panels are more effective than blackboard drawings or projected slides. This one illustrates parallactic displacement in the pupil to determine depth of posterior polar cataract in ophthalmoscopy.

techniques, are valuable teaching aids and if well prepared are worth the time and expense involved. If they can be used, color movies are preferable. Sound films are commercially available on numerous opthalmic topics and are effective teaching aids.

Charts and drawings

The use of the blackboard should be restricted to the minimum. If it is used "ghost drawings" add to its effectiveness. These drawings in dark blue chalk, put on before class, are invisible to the student, but visible to the instructor. The instructor can then produce at the proper time an accurate, fairly rapid illustration by drawing with white chalk over the "ghost drawing." The newer boards which are white instead of black and upon which drawings in colored crayon may be placed give higher visibility than do the usual blackboards and are a distinct advantage if more than one color is used.

Large illustrations placed on sliding panels, which can be pulled into view when needed and as quickly pushed from sight, are more effective than blackboard drawings (fig. 3). The illustrations can be more carefully and accurately prepared to insure the minimum of confusion on the part of the student. The instructor can concentrate all his energy on explaining his subject rather than on his drawing. His explanation is, therefore, smoother and more logical. He can use more illustrations in the same period of time without the confusion of blackboard erasures. Once an instructor has used this method and noted the increased student comprehension, he will not willingly return to

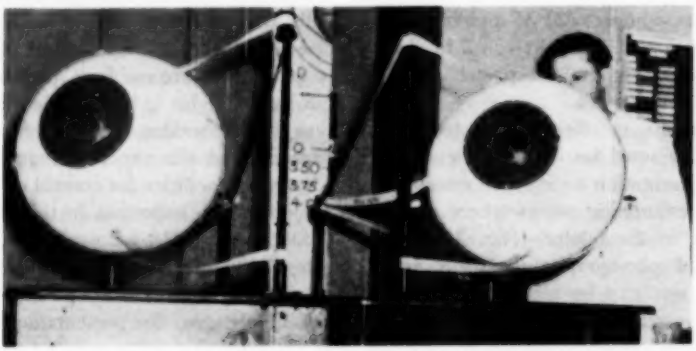

Fig. 4 (Byrnes). Motor-driven ophthalmotrope. These eyes can be moved laterally, vertically, or diagonally, either alone or together. Explanation of normal and abnormal extraocular muscle action is made more effective.

the use of blackboard illustrations. These charts have the very definite advantage over slides and movies in that the room is not darkened and the important personal instructor-student relationship is more readily maintained.

Tridimensional models

It is in the tridimensional model that the ingenuity of the ophthalmic instructor has its greatest field. Models which simulate actions or functions are especially useful in explaining difficult concepts. It is possible in many instances to reduce teaching time for

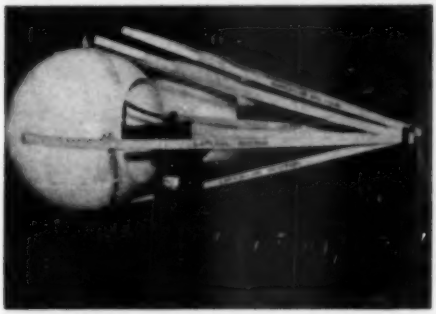

Fig. 5 (Byrnes). Posterior view of ophthalmotrope showing driving mechanism and electrical controls.

a specific subject, such as action of eye muscles, to less than one third of that previously required and at the same time to increase student understanding of the subject.

Motor-driven ophthalmotrope. This instrument was conceived by R. G. Scobee and was designed, built, and reported by Reeh.* Figures 4 and 5 show the front and side views of the apparatus. By its use primary and secondary actions of the extraocular muscles can be readily demonstrated as well as the changes in muscle action which occur with changes in eye positions. The designation of synergists, antagonists, and the yoke muscles can be shown. The findings with the cover test showing the difference between heterophoria, paretic heterotropia,

* Am. J. Ophth., 30:58-59 (Jan.) 1947.

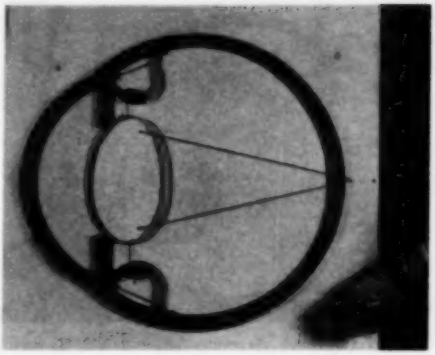

Fig. 6 (Byrnes). Accommodation model. In this position the dark threads simulate the position of the focal point when diverging rays of light from a point on a near object enter an emmetropic eye with its accommodative mechanism at rest. These rays of light would come to a focus behind the retina.

and concomitant heterotropia can be readily shown. It is useful in explaining monocular and binocular projection of images, especially in conjunction with the projection-of-images model to be described.

The eyeballs themselves are constructed of plastic, molded especially for this apparatus. They are moved by two reversible electric motors on each eyeball. The mechanism is protected by cut-off switches which automatically stop the current flow when the limit of desired rotation has been reached. Figure 5 demonstrates the mechanism of this model. The simulated eye muscles are made of elastic material which contracts when tension is relieved.

The control panel is also shown in Figure 5. Each of the two toggle switches on the right turns off all current to one eye so either eye can be used alone or so that action occurring in one eye can be stopped at any point to simulate paralysis. The two switches at the left control directional movements. The rear one controls lateral movements; the front, vertical movements. Diagonal movements are achieved by using the two simultaneously. Torsional movements could be produced by the use of one additional

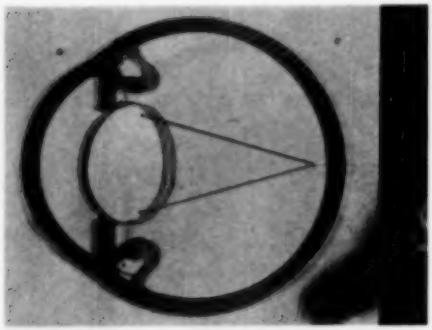

Fig. 7 (Byrnes). Accommodation model. By turning the knob the ciliary body can be seen to move forward, thus relaxing the pull on the simulated zonule. This in turn permits the lens to become more spherical through its own elasticity and the focal point is brought forward in the eye.

motor in each eye and one more switch.

For use in a basic course in ophthalmic physiology involving action of the eye muscles, this is the best training aid ever used in this institution.

Accommodation model. Figure 6 illustrates a model which was rather simple to construct and which demonstrates the Helmholtz theory of accommodation. The model is a silhouette of an eyeball cut from plywood and mounted on a plywood base. The ciliary body and the lens are made of brass strips of springy metal. The operating mechanism is illustrated by the photograph of the back of the model (fig. 8). As the knob in the lower right corner is turned, the ciliary body comes forward decreasing the diameter of the circumlenticular ring. This relaxes the pull on the simulated zonule and the lens becomes more spherical because of its own elasticity (fig. 7). At the same time the focal point comes forward.

The use of this model serves to emphasize and give the student a visual impression of the mechanism of accommodation. It has been found useful for instruction of physicians, nurses, and technicians.

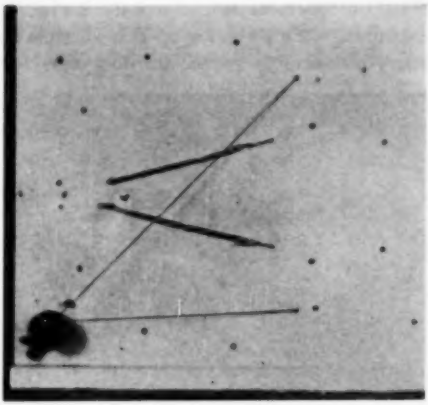

Fig. 8 (Byrnes). Rear view of accommodation model showing its mechanism.

Retinoscopy model. This apparatus was designed to demonstrate the reflex seen in

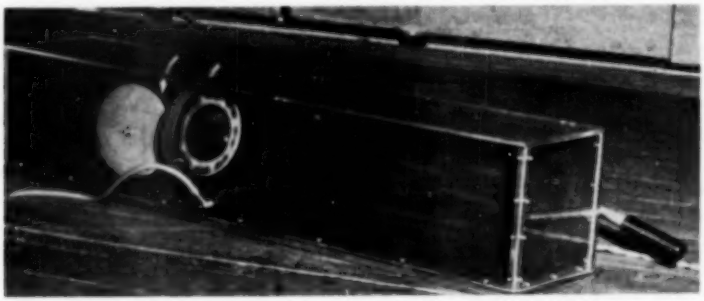

Fig. 9 (Byrnes). Model to demonstrate retinoscopy. The bottom, back, and left end are dull black. The top, front, and right end are of clear lucite. A biconvex lens with painted "iris" simulates the refracting media of the eye. The "retinal" disc with central light spot can be moved both vertically and horizontally.

the eye of the patient during retinoscopy. Many students want to know why hyperopia produces a "with" motion and myopia an "against" motion. With the apparatus here described, the student can see the direction of motion of the reflex, the length of the eyeball, and the actual convergence or divergence of the light rays emerging from the eye. In addition, the use of cylinders permits demonstration of the conoid of Sturm.

The model was built in a black box with a clear lucite front, top, and right end (fig. 9). A small brass hollow tube was screwed into its front so cigarette smoke could be blown into the box to demonstrate the paths of the light rays concerned. A rubber tube with short replaceable aluminum tips kept in an alcohol solution allows sanitary use of the model by a whole class.

The lens system of the eye is represented by two plano-convex lenses obtained from an old projector and placed back to back in a frame as shown in Figure 9. Between them is placed a disc of paper cut and painted to represent the iris. The retina is represented by a curved sheet of aluminum which has been painted a dusty pink. In its center is a small electric light bulb to represent the illuminated spot of retina in retinoscopy.

This metal "retina" is mounted on an arm and can be moved by a rack and pinion gear toward or away from the lens system (see fig. 10). The center of its span of movement is at the focal length of the lens system so either hyperopia, myopia, or emmetropia can be simulated by moving the "retina."

It was found necessary to have a means of moving the "retina" from outside the box in order to prevent loss of smoke each time the retinal positions was changed. An external handle was applied to the box so the simulated light spot on the retina can be readily moved up and down while the observer looks through the pupil through the right end of the box.

It was found necessary, psychologically,

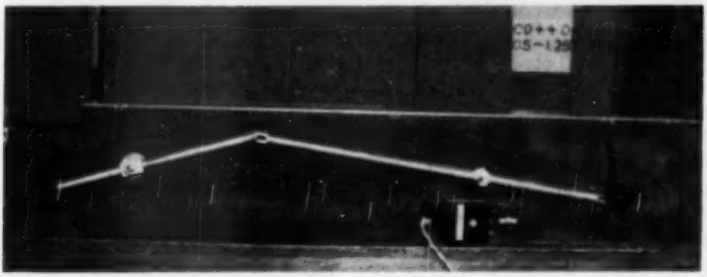

Fig. 10 (Byrnes). Rear view of retinoscopy model showing the bar used to move the retinal light spot vertically and the rack-and-pinion gear knob which moves the retina to "hyperopia," "myopia," or "emmetropia."

to have the light move in the same direction as the handle (for example, when the handle is moved down, the light moves down) in order to prevent student confusion. For this reason the handle was hinged in the middle and mounted as shown in Figure 10, showing the back of the model.

In using this model it is first filled with smoke. The student is informed that the light projected into the patient's eye always moves in the same direction as the retinoscope, regardless of the patient's refractive error (if plane or slightly concave mirror retinoscope is used). This can be demonstrated in a dark room by turning out the light in the model and using an actual retinoscope on this model eye with the retina in the hyperopic, emmetropic, and myopic position, if desired.

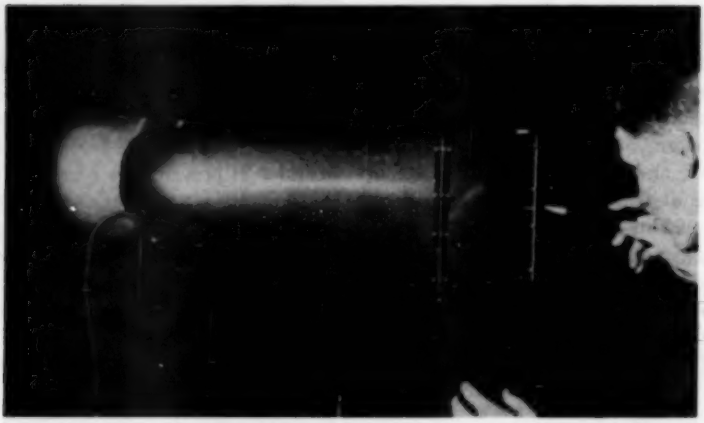

Fig. 11 (Byrnes). The retinoscopy model in use with the retina in the "myopic" position. The emergent rays from this long eyeball obviously come to a focus and cross in front of the nodal point of the observer. He therefore sees an apparent "against" motion of the reflex in the pupil.

The retinoscope is then removed and the light in the model is turned on to represent the moving spot of light on the patient's retina. The retina is set in the myopic position and the emerging rays of light are shown in the smoke to be converging anterior to the nodal point of the observer, to have crossed and be diverging (fig. 11). He, therefore, sees an "against" motion when he looks into the pupil through the right end of the box as he moves the lever on the back of the box.

The retina can now be gradually brought to the point of emmetropia and the "flash point" demonstrated to the student. The smoke in the box shows that this occurs just as the rays of light come to a focus on the observer's nodal point.

As the retina is now brought closer to the

Fig. 12 (Byrnes). Prism-action demonstration. The water-filled lucite prism intercepts the beam from a projector chart. It displaces the spot of light on the sanded lucite screen at the left in the direction of the base of the prism.

Fig. 13 (Byrnes). Prism-action demonstration (second part). After seeing that the light actually deviates toward the base of a prism (fig. 12), the same light source is viewed without the screen and, when the prism is placed in front of the light, it apparently moves toward the apex of the prism.

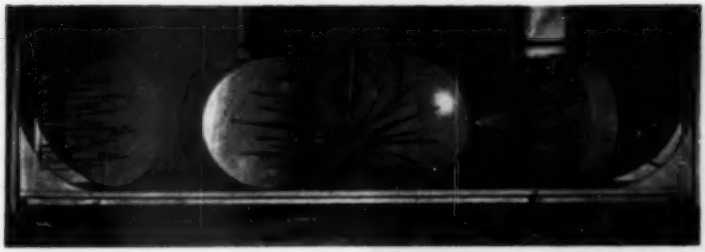

Fig. 14 (Byrnes). Wooden lens models to illustrate the shape of spheres and cylinders. Their optical effects are demonstrated by black wires. Virtual foci of minus lenses are demonstrated by yellow wires.

lens system and the eye becomes hyperopic, the emerging rays of light come to a focus behind the nodal point of the observer and he sees a "with" motion. As the retina is brought still closer to the lens the rays of light can be seen to diverge.

This model is very useful in explaining refraction to students. The use of actual lenses, light, and smoke has been found superior to previous explanations attempted with simulated light cones of string or by the use of diagrams.

Prism action demonstration. In teaching optics there are two effects produced by prisms which sometimes confuse students. A prism bends rays of light toward its base, yet the image and the eye are displaced toward its apex. At first glance these seem contradictory but a single demonstration can clear this for the student.

A large plastic prism was built so it could be readily seen by the whole class. When filled with water it has a strength of 14 prism diopters (fig. 12). A visual-acuity chart projector is used as a light source and placed behind a sanded plastic screen. A spot of light is projected onto the screen from behind. The prism is then placed to intercept the beam. It is thus shown that a prism bends rays of light toward its base. The screen is then removed and the class looks directly at the light source (the projector). See Figure 13.

The prism is again inserted in the same position and the light source seems to move toward the apex of the prism. A large chart is then used to demonstrate why the apparent contradiction occurs and why the eye rotates toward the apex of the prism. It requires less time to explain than with blackboard technique, and student retention is much higher.

Lens model. To the beginner in optics the physical shapes of spheres and cylinders are often difficult to understand and their effect on light rays even more so. To save teaching time and student study time, lens models were constructed of wood, and wires were inserted to simulate rays of light (fig. 14). Parallel wires enter one side of the lens and emerge on the opposite side showing the

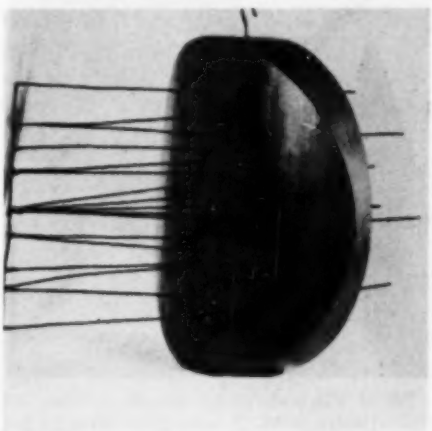

Fig. 15 (Byrnes). Plano-convex cylinder model showing parallel rays of light being brought to a focus in a line parallel to its axis.

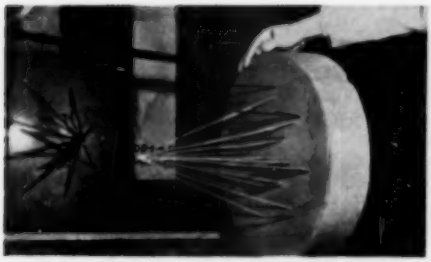

Fig. 16 (Byrnes). Plano-concave sphere showing parallel rays (black wires) on the left side of the lens emerging on the right side diverging. These diverging rays are projected back to a virtual focus on the left side of the lens (yellow wires). The wooden lens at the left is a plano-convex sphere.

optical effect. Figure 15 shows a plano-convex cylinder bringing parallel rays of light to focus in a line parallel to its axis.

The virtual focal point and focal line of minus spheres and cylinders are even harder for the average student to comprehend. In the wooden models, parallel black wires representing light rays enter one side of the lens and emerge diverging. These diverging "rays" are projected back through the lens as yellow wires to form a "virtual focal point" or "virtual focal line." See figure 16.

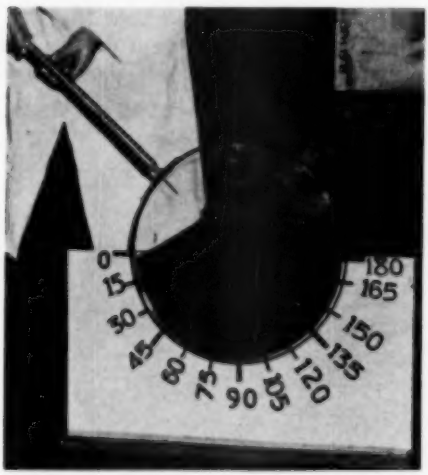

Fig. 17 (Byrnes). Trial-frame cell, cylinder, and cross-cylinder model. A large plastic cylinder can be rotated in a wooden trial-frame cell with axis marking on it. The model cross cylinder can be readily "flipped" in front of the cylinder to illustrate its use.

Cylinder, trial frame and cross cylinder model. Poor results were obtained when trying to teach the use of the Jackson cross cylinder to a whole class by the use of diagrams and blackboard drawings. For this reason this model was constructed (fig. 17).

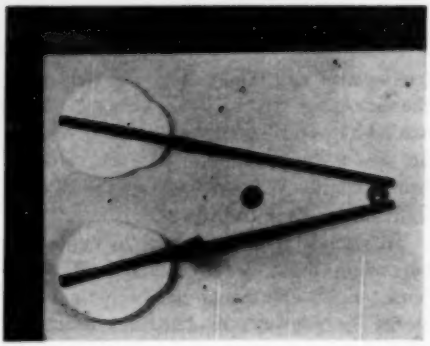

Fig. 18 (Byrnes). Model to demonstrate projection of images. Two flat wooden eyeballs rotate at their centers and can be loosened or tightened by set screws on the back of the board. To each is affixed a wooden strip representing the visual axis. In addition, each eye has a metal strip in a contrasting color attached by set screw at the nodal point. These metal strips can be elongated to any point by painted steel measuring tapes which have been attached to them.

It consists of a large plastic cylinder to simulate one from a trial frame. A wooden mount was built which shows trial-frame markings in degrees and in which the cylinder can be readily rotated. A large cross cylinder was made of plastic. When a demonstration is made using patient response and actual movement of cylinder axis as the cross cylinder is rotated, students comprehend readily.

Projection of images model. The classical explanation of physiologic diplopia, showing the point to which images are projected as being the point the image would occupy if the retina were stimulated at a point twice as far away from the macula as

the one actually being stimulated, does not appeal to students. They can see no reason psychologically why that should occur. Drawings and diagrams are ineffective. If, however, the statement is made that the image is projected to the point it would occupy if the visual axes were fixed on the object producing the image, that is more readily accepted by the student.

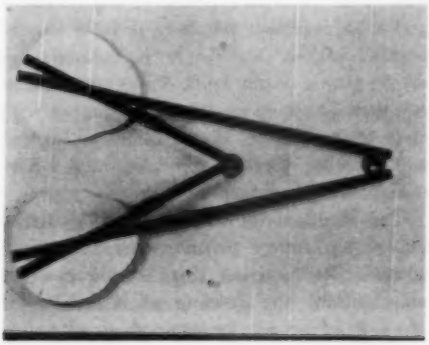

Fig. 19 (Byrnes). Projection of images of objects nearer than the object being "fixed." If visual axes are fixed on Point B, the position of the retinal image of Point A in the temporal fields of both retinas can be shown. The point to which these images will be projected is shown in Figure 20.

A model to demonstrate this concept was built with two plywood eyes fastened at their centers of rotation to a board so they could be turned (fig. 18). Their visual axes are firmly attached and rotate with the eyes. In addition, two strips of metal were attached to rotate at the nodal point to show which peripheral retinal area is stimulated by objects in the visual field not being fixated. Steel measuring tapes in their cases are attached so they can be pulled out to the desired distance for any object.

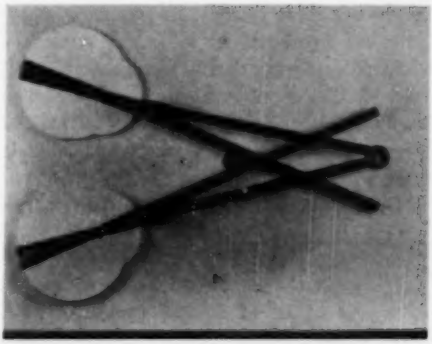

Fig. 21 (Byrnes). Projection of images of objects farther away than the object being "fixed." Visual axes are fixed on Point A. Images of Point B, therefore, fall on the nasal side of each macula. The point to which these images will be projected is shown in Figure 22.

In Figure 19 is shown the visual axis fixed on point B. Point A in the visual field produces an image falling in the temporal peripheral retinas in both instances. If now the visual axes are rotated to the object

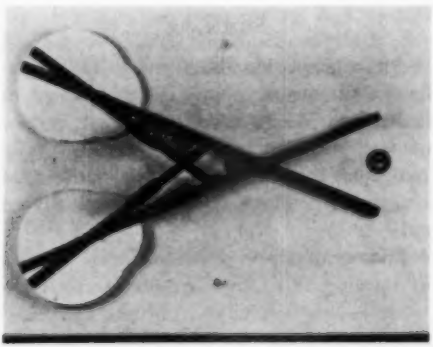

Fig. 20 (Byrnes). Point to which images of Point A will be projected when visual axes are fixed on Point B.

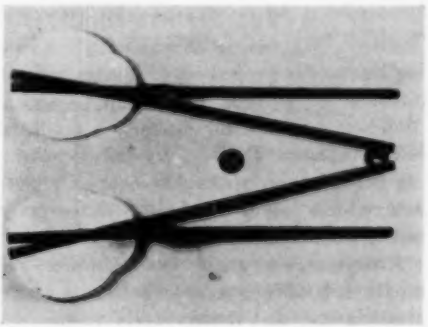

Fig. 22 (Byrnes). Point to which images of Point B will be projected when visual axes are fixed on Point A.

producing these images, the point to which they are projected is indicated, while the visual axes are actually fixating point B (fig. 20). For objects farther away than the object being viewed, Figures 21 and 22 show the location of the uncrossed diplopia images produced.

This model is also useful in demonstrating monocular projection of images and the direction of rotation of the eye behind a Maddox rod when the diplopia is produced in heterophoria. It also is useful in explaining the direction of displacement of images in a red-lens test or in a Lancaster red-green test in heterotropia.

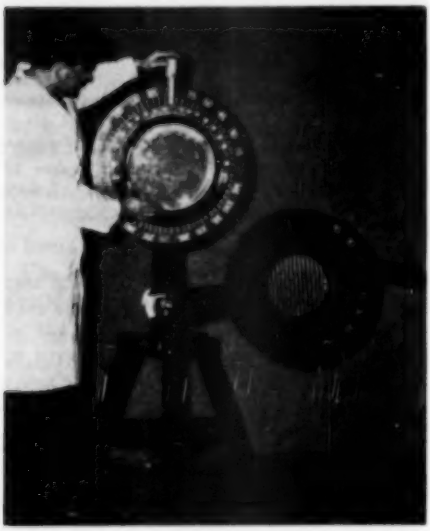

Fig. 23 (Byrnes). Risley rotary prism and Maddox rod model. By its use explanations of the effect of a multiple Maddox rod can be shown. Rotation of the lucite prisms in the rotary prism also demonstrate why the base of the effective prism remains constantly at 90 degrees from the 0-degree point and the effective prism power can be increased.

Risley rotary prism and Maddox rod model. It is difficult to explain the use of the Maddox rod and Risley rotary prism to a group too large to gather closely around the instructor. The large model here described has been found very useful (fig. 23).

The multiple Maddox rod is made of a large metal disc which can be rotated around 360 degrees. The optical portion of it is made of lucite rods fastened tightly together. When a small spot of light is held behind it, it is converted into a bright line of light easily seen by the class. It serves to eliminate the doubts of some members of the class who know the rods are only strong cylinders and who feel that the line of light should parallel rather than be at right angles to the long axis of the rods. This phenomenon can then be easily explained by the use of a large chart. The position of the Maddox rod when testing vertical and horizontal heterophoria can be shown.

The Maddox rod is then turned down and the Risley rotary prism model is demonstrated. Its position for testing various phorias and the reading of its dial for strength of prism is explained. Explanation is also made of why the effective base and apex of the prism are always at 90 degrees from the 0 mark. Too frequently students get the impression that the prism base is located at the indicator line for reading strength of prism. This explanation is facilitated by the use of two large plastic prisms of the type mentioned under "Prism demonstration," and a large chart on a sliding panel.

Summary

An attempt has been made to review briefly the major points of importance in instruction in ophthalmology. These consist of well-prepared material, presented by a competent instructor in a properly designed classroom, with use of effective training aids.

Photographs are presented of a number of training aids which are deemed effective in explaining ophthalmic concepts and fixing this information in the minds of the students.

U.S.A.F. School of Aviation Medicine.

BETA-RAY APPLICATION TO THE EYE*

WITH THE DESCRIPTION OF AN APPLICATOR UTILIZING Sr^{90} AND ITS CLINICAL USE

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Interest in beta radiation rests primarily on the desire to exploit the unique physical characteristics of beta rays (high-speed electrons) which limit the ionizing radiation to superficial tissue, thereby preventing damage to deeper structures.[1, 2]

Available data indicate that the qualitative and quantitative differences, with regard to biologic effects of radiation, which may exist between beta rays and X rays (or gamma rays) are not large and the minor discrepancies that may be present are of little significance.

The biologic effects produced by radiation are now considered to be due primarily to ionization resulting from high-speed charged particles or from high-energy electro-magnetic radiation (X rays and gamma rays). With high-energy X rays or gamma rays most of the ionization is produced by secondary electrons (resulting from photoelectric absorption and Compton scattering of the gamma ray).

Beta rays are, in effect, high-speed electrons. The means of producing ionization in tissue is, therefore, essentially the same both for beta rays and high energy X rays and gamma rays. In circumstances in which protection beneath the surface is not of critical importance, beta rays possess no biologic advantage over the conventional and commercially available low-voltage X rays.

In fact, there are many reasons why low-voltage X ray is superior to beta rays since it permits a wide variation in the size of the field to be irradiated; the machine can be more easily protected and is, of course, not radiating when the current is turned off; the intensity is usually much higher than with beta-ray applicators; and the problem of calibration is simpler in the case of X rays, particularly if the beta rays arise from an element of comparatively short half life.

Only under special circumstances do beta rays possess a unique and special advantage. Such a circumstance is radiation to the eye. The lens, known to be sensitive to excessive radiation, may suffer cataractous changes.

A low-voltage X-ray machine, such as the Philips unit, produces at contact, and without added filter, a 23-percent depth dose at 10 mm.;[3] whereas with ordinary beta rays the dose at 10 mm. is less than one percent. It is therefore clear that radiation about the cornea can be more safely achieved with beta radiation than with ordinary low-voltage X rays. It is possible, however, to approximate the penetration of beta rays in tissue with special low-voltage X rays which are not generally available commercially. Such X irradiation would result in comparable biologic effects on the surface and still provide protection to the deeper structures.

PHYSICAL CHARACTERISTICS OF IONIZING PARTICLES

In order to appreciate the significance and biologic importance of various types of ionizing radiation it may be useful to review the pertinent physical characteristics of the more familiar ionizing particles and electromagnetic radiation. The ionizing particles which are most important biologically are the alpha and beta particles, sometimes called alpha rays and beta rays (fig 1). Gamma rays and X rays are frequently considered

* From the Departments of Radiology and Surgery (Division of Ophthalmology), Western Reserve University and University Hospitals of Cleveland. Most of the work was performed under Atomic Energy Commission Contract No. W-31-109-eng-78 with Western Reserve University. Presented at the 18th scientific session of the Association for Research in Ophthalmology, Inc., Philadelphia, June, 1949.

with the ionizing particles since their energy is often thought of as being emitted in "pulses" (quanta or photons). Other particles of importance which we will not consider here are high-speed protons, neutrons, deuterons, and recoil nuclei of light elements.

Beta rays and fast-moving ionizing particles are assigned energies in suitable units, usually electron volts. These units are related directly to the mass and speed of the particle. The energies of photons are given in similar units. In the case of the photon, the energy is a function of the wave length —the shorter the wave length the more energetic the photon.

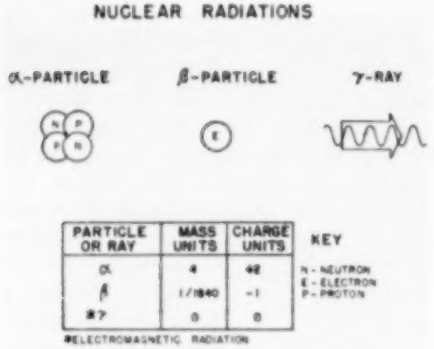


Fig. 1 (Friedell, Thomas, and Krohmer). Graphic presentation of nuclear particles and some of their important characteristics.

An alpha particle is the nucleus of a helium atom, having an atomic weight of four and a positive charge of two (fig. 1). The particle penetrates tissue or other materials a fixed distance which is known as the range of the particle and is dependent upon the initial energy. An alpha particle having an energy of five million volts would have a range of about 3.8 cm. in air and about 40 micra in tissue—essentially a few cell diameters.

Alpha particles of ordinary energies are of no consequence biologically unless the radioactive element producing alpha radiation is introduced directly into the tissues, as, for example, by intravenous or subcutaneous injection. All alpha particles arising from any specific disintegration are monoenergetic in that all the particles have the same energy.

This is in contrast to beta particles which have varying energies from the nuclear disintegration of any specific radioactive element so that a continuous spectral distribution of energy results. Beta-ray energies are usually given as peak energies. The peak energy is generally three to four times the average energy.

Beta rays are high-speed electrons. Their mass is negligible compared to alpha particles—an electron having a mass of approximately 1/1,850 of a neutron or proton. They have a single negative charge which is exactly equal to the positive charge possessed by a proton.

Usually beta particles are less energetic than alpha particles. Since their mass is very small, however, their speed is much greater for equal energies and their range in air is accordingly much greater than alpha particles. In tissue, a beta particle having an energy of one million volts will have a range of approximately four mm. which is much larger than that of the alpha particle of similar energy and, therefore, can penetrate deeply enough to be biologically effective from an external source (fig. 2).

Ionizing electromagnetic radiation (X rays, gamma rays) can be assigned specific energies, as noted above, and it is often advantageous to think of gamma rays as photons or quanta in which the "pulses of radiation" contain a specific amount of energy.

Gamma rays, compared with beta rays or alpha particles, are very poorly absorbed in tissue and a gamma ray or photon (a single quantum of electromagnetic energy) having an energy, for example, of one million volts would be 99 percent absorbed in tissue, on the average, only after traversing 70 cm.

In a hypothetical instance, where an alpha particle, a beta ray, and a gamma ray exist

side by side, having exactly the same energy —we will assume an energy of one million volts for each—the alpha ray would be completely absorbed, or its one-million-volt energy would have been given up in 7.5 micra; the beta ray would be completely absorbed in four mm. of tissue, or 4,000 micra; the gamma ray would be 99 percent absorbed in approximately 70 cm. of tissue.

Since radiation dose, as will be seen later, is essentially defined as ionization per unit volume, it is clear that the highest dose would result from the alpha particle since the entire one-million volts, eventually converted to ionization, would be confined to a very short path.* The next greatest dose would result from a beta particle, since it would lose its one-million volts of energy, eventually being converted into ionization, in four mm. of tissue. The smallest dose would occur with a gamma ray since it would lose its one-million volts in approximately 70 cm. of tissue.

It is therefore clear that if one beta ray is accompanied by one gamma ray (assuming energies of one million volts for each), most of the radiation dose is produced in the path of the beta ray (approximately four mm.). The gamma ray would contribute only a very small additional dose along the path which would correspond to the beta-particle range. It should be pointed out, however, that it is possible to introduce enough gamma rays so that even though they are poorly absorbed, the ionization density can be made very intense—the radiation dosage being correspondingly high.

In most instances it is, therefore, of no importance from the point of view of treatment as to whether gamma rays, assuming they do not greatly outnumber the beta rays, are present in addition to beta rays, since the dosage is limited by the beta-ray effect. Efforts to eliminate gamma radiation when energetic beta rays are to be utilized biologically are useful only from the point of view of protection of the operator and the attendant. The precautions which are necessary for gamma rays, however, can be easily observed if proper cognizance is given to this hazard. The problem is considerably simplified, of course, when no gamma rays are emitted.

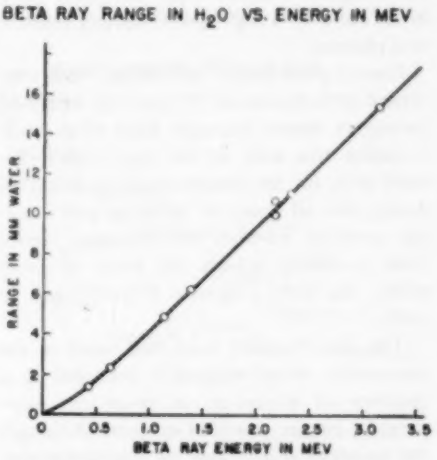


Fig. 2 (Friedell, Thomas, and Krohmer). Penetration or range in water of a beta particle plotted against its energy. Soft tissue may be considered comparable to water.

Measuring beta irradiation

It is pertinent to discuss here the quantitative units by which it may be possible to measure the radiation and radiation dosage from beta rays.

It has proved profitable during the years in which X rays have been used for therapeutic purposes to utilize a dosage measurement which is dependent upon ionization in air. This unit of measurement, the roentgen, is concerned with the ionization produced in a fixed mass of air as a result of incident X rays or gamma rays.

This type of unit, in addition, fits in well

* We are considering here merely ionization effect which can be converted into radiation dose. There is a special quantitative biologic effect due to alpha particles which is related to the specific ionization—that is, the density of ions per unit of path. It is not pertinent to our discussion at this time.

with the generally held belief that the biologic effects of radiation are due to the ionization which is produced in tissue and the subsequent chemical effects resulting from such ionization. (Ionization, or the production of an ion pair, is the result of removing an electron from the outer shell of an atom by a high speed charged particle or a photon).

Since a great deal of the biologic data concerned with the use of X rays is in terms of roentgens, recent attempts have been made to utilize this unit, or one very closely related to it, for the measurement of radiation dosage for all types of radiation and ionizing particles whether the radiation comes from a source outside the body or from within the body (ingested P^{32}, I^{131}, and so forth).

This has resulted more and more in the conception of an equivalent roentgen as a measure of ionization in tissue, or, more directly, energy absorbed in tissue. Although the roentgen still retains its official designation as a measure of ionization *in air*, serious consideration is given to the point of view of measuring or estimating the energy which is absorbed *in tissue* (or tissue ionization) from the incident radiation in a closely related unit, called variously the gram roentgen, roentgen equivalent physical (rep), or tissue roentgen. All these have the same basic concept—that is, energy absorbed in tissue.

One roentgen equivalent physical or tissue roentgen is considered to represent 84 ergs absorbed in one gram of tissue. This is based on a calculation of the energy absorbed from one roentgen in one gram of air. In the case of beta ray sources it is, therefore, possible to calculate the dose in roentgen equivalents physical by measuring the number of particles of known energy absorbed in a known volume of tissue.

The volume can usually be determined by the surface irradiated and the range of the particles or penetration into the tissue (directly related to the energy). It is possible also to measure directly the ionization produced by means of special chambers and record the dosage in equivalent roentgens (in our case, in tissue roentgens or roentgen equivalent physical). This last method has been used for the measurement of dosage arising from the Sr^{90} applicator which will be described.

Many previous measurements of radiation utilizing beta rays and gamma rays from radioactive materials designated the dosage in the amount of radioactive element and the length of time of exposure, such as milligram hours, milligram seconds, millicurie seconds, gram seconds, and so forth. This is an unsatisfactory dosage measurement and generally should be avoided unless all the physical characteristics of the radiation source, its geometry as related to the surface to be irradiated, the filtration, and so forth, are all carefully noted.

Although this concept of dosage has been useful, and is still useful when the kind of applicator, the filtration, and the manner of application are all fixed, it does not permit ready comparison with other types of radiation and actually places a burden upon others to determine the exact dosage for comparison with other types of radiation.

Beta-ray sources

Beta-ray sources, until the invention of the cyclotron in 1931 and, more recently, the development of nuclear chain reactors or piles, have depended upon those readily available naturally occurring radioactive elements which emitted an abundance of beta rays. Most important of these has been radium and its chain of decay products. Figure 3 shows the decay of radium through its daughter products and the various types of particles that are emitted. (It may be observed that most of the beta rays are emitted by Ra B and Ra C.) Ra C, being the most energetic, is the effective particle. It has a peak energy of 3.15 million electron volts (mev) and an average energy of 0.65

mev. The average range in tissue is, therefore, approximately 2 mm. (fig. 2).

There is essentially no difference between radium and radon as a source of beta rays since they emit exactly the same particles except for the alpha particle arising from radium proper. When radium is present, however, the self-absorption due to the mass of radium is great enough to reduce the number of beta particles which escape from the applicator into the biologic tissues. Therefore, beta rays arising from radon of exactly the same strength as radium result in a greater number of beta rays and a more intense biologic effect.

Radon, which is a gas and is continually emanated from the radium solution, can be pumped off, separating the radium from the radon. Radon will then rapidly produce the remainder of the decay products to Ra D. (Radon pumps which have been developed previously for making gold radon seeds have been used to make glass radon bulbs for beta-ray sources.)

More recently Ra D has been utilized as a source of beta particles. As may be observed (fig. 3), Ra D is one of the daughters in the chain arising from radium and can be recovered in large amounts from old radon sources or separated from radium and its decay products. It has a half life of 22 years and decays by the emission of a very weak beta ray to Ra E (plus a weak gamma ray) which, in turn, emits an energetic beta particle having a peak energy of 1.17 mev. Therefore, the Ra D plus Ra E can be utilized as a source of beta rays. The beta ray which is most effective, of course, is the energetic beta particle arising from Ra E (fig. 3).

Recently it has been possible to produce in considerable amounts a great many artificially radioactive elements which may be suitable for beta-ray applicators. Table 1 shows a number of isotopes that emit beta-ray energies of sufficient strength to be useful and that have half lifes which are long enough to be considered for this purpose. The criteria for selection of an element for any beta-ray emitter are essentially:

1. That the half life, or rate of decay, be sufficiently long so that replacement or replenishment is at a minimum.

2. That it be unaccompanied by gamma rays so that the problems of protection of the operator are more easily solved.

DECAY SCHEME FOR RADIUM

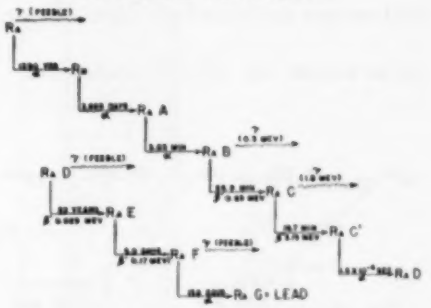


Fig. 3 (Friedell, Thomas, and Krohmer). This diagram shows the decay of radium through stable lead. From newly formed radon all the daughter products up to Ra D are rapidly brought into equilibrium and contribute to the radiation from a radon applicator. Ra D, because of its long half life, comes into equilibrium slowly; therefore it contributes practically no radiation to a radon beta-ray applicator. This scheme shows only the important gamma rays. The complete decay scheme is somewhat more complex than is depicted. The beta particle from Ra C is the important one. As may be observed, it has a peak energy of 3.15 mev, the average energy however is 0.65 mev.

TABLE 1

ELEMENTS EMITTING ONE MEV* OR STRONGER BETA RAYS WITHOUT GAMMA EMISSION
(half life two weeks or more)

Isotope	Energy (mev*)	Half Life
P^{32}	1.69	14.3 days
Rb^{86}	1.60	19.5 days
Sr^{89}	1.50	55 days
Sr^{90} series	0.65	25 years
Y^{90}	2.16	62 hours
Y^{91}	1.53	57 days
Ru^{106} series	Very soft	1 year
Rh^{106}	4.5	30 seconds

* Mev = million electron volts.

3. That the beta rays have sufficient energy so that their range in tissue will be suitable for biologic purposes.

4. That the material has suitable chemical characteristics so that it may be manipulated and handled easily when being placed in an applicator.

Physical characteristics of Sr^{90}

Of these materials Sr^{90} appears to be an ideal element and accordingly about 100 mc.

DECAY SCHEME FOR SR^{90}-Y^{90} COMBINATION

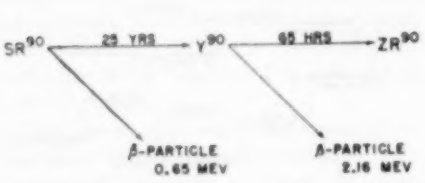


Fig. 4 (Friedell, Thomas, and Krohmer). Sr^{90} decays to stable zirconium. There are two beta particles emitted after Y^{90} has come into equilibrium with strontium. The most useful particle arises from the yttrium daughter, being the most energetic.

were obtained from the Isotope Division of the Atomic Energy Commission for the fabrication of a suitable applicator.

In accordance with the criteria noted, strontium has a long half life. It is unaccompanied by gamma rays and has an energetic particle so that its penetration is adequate. It can be handled comparatively easily since it is quite soluble in acid solutions.

As may be observed from Figure 4, Sr^{90} has a half life of 25 years, which means that there is very little change in the radiation over any considerable length of time. The dosage decreases about 2.7 percent per year.*

Sr^{90} emits two beta particles before decaying to stable zirconium. The first of these is weak and contributes only slightly to the radiation dose. The second of these is quite energetic and penetrates, on the average, about 3.0 mm. beneath the surface, producing most of the radiation effect.

Measurement by means of an extrapolation ionization chamber at the surface of the applicator has indicated a dosage of 5.4 equivalent roentgens per second. It was found that 50 percent of the beta particles

PERCENT DEPTH DOSE FOR 44 KV X-RAY AND SR BULB

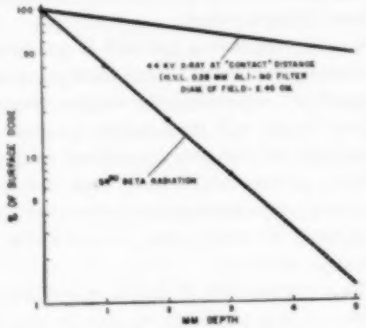


Fig. 5 (Friedell, Thomas, and Krohmer). The radiation dose is plotted against depth. The rapid fall of the Sr^{90} beta radiation is compared with superficial contact X ray.

which impinge upon the radiating surface were allowed to pass through the lucite and aluminum window and that the half value

* The Sr^{90} proper decays by emission of a beta particle which has a peak energy of 0.65 million electron volts (mev). Since beta rays have a spectral distribution, this means that only a few of the particles penetrate very far into tissue and the average energy (about 0.3 of the peak) corresponds to about 0.195 mev. The beta rays from Sr^{90} proper are, therefore, not very useful in contributing to the radiation effect since the penetration of a particle having an energy of 0.195 mev is 0.35 mm. in tissue. However, the daughter which arises from Sr^{90} (Y^{90}) has a very energetic beta particle having a peak energy of 2.16 mev and, having an average energy of approximately 0.8 mev, the range of this particle is considerably greater. A few of the particles will penetrate as much as 11 mm.; whereas, on the average, the particles penetrate approximately 3.0 mm. of tissue. Y^{90}, having a half life of 62 hours, is very rapidly brought into equilibrium with Sr^{90}, so that for each disintegration of Sr^{90}, two beta particles arise, one from the Sr^{90} proper and one from Y^{90}, the most effective one, of course, being the energetic particle from the Y^{90}.

layer of this usable radiation is 0.9 mm. in tissue (fig. 5). This radiation is now being compared with our radon bulb applicator to determine the dosage relationships.†

Preliminary data indicate that the penetration of radon beta rays is somewhat less than the pentration of Sr^{90} beta rays. This fits in with the available physical data which reveal that the average energy of the beta particle from Ra C (the most energetic one) is 0.65 mev. The average energy for a Sr^{90} beta particle is 0.8 mev.

Description of Applicator

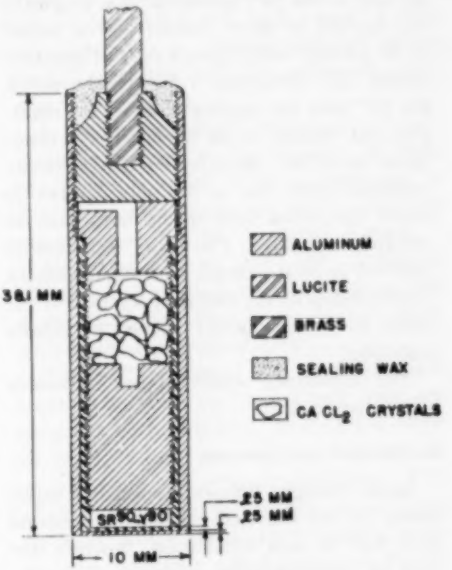
The applicator consists of a lucite capsule which is, in turn, enclosed in an aluminum capsule (fig. 6). The ends of the lucite capsule and aluminum capsule were made as thin as possible (0.25 mm.) to allow a maximum number of beta rays to escape from the bulb.

The strontium was introduced into the lucite capsule in the form of a chloride solution which was evaporated in the capsule by passing warm dry air over the solution.

The aluminum covering was added to the lucite in order to provide strength and support. In addition to this, it is essential that the lucite be encased in metal since under the continuous bombardment of beta rays, the lucite will disintegrate. The aluminum capsule was then sealed with a plunger, fitted with a 15-inch handle, and covered with extra metal along the sides and posteriorly to minimize the radiation escaping from the container proper.

There is a small amount of beta rays and Bremsstrahlung present (Bremsstrahlung are weak X rays produced by the interaction of the escaped beta particle and the nucleus of the surrounding atoms). It was, therefore, considered advisable to provide considerable distance between the point at which the applicator is grasped and the radiating surface.

The exact description of the manner of filling the applicator will not be included here. However, the applicator was filled under such precautions as to eliminate possible loss of material and resulting contamination of the environment. Since the filling of the bulb was done on a laboratory basis, it is not improbable that future preparation, especially by a commercial firm, would produce a superior applicator.



STRONTIUM EYE BULB

Fig. 6 (Friedell, Thomas, and Krohmer). Diagrammatic sketch of the beta-ray applicator. The clear space just above the radiating surface contains the strontium chloride. The Sr^{90} is carrier-free (no stable strontium, but other impurities are present). The calcium chloride removes any moisture that may inadvertently be present. This keeps the strontium chloride chemically inert and avoids corrosion.

Clinical Application

Sr^{90} beta rays have been applied clinically

† Calculation of the dosage which might arise from our Sr^{90} applicator should compare favorably with actual measurements, but this is somewhat difficult in our own applicator due to the uneven distribution of the Sr^{90}. Because of minor technical difficulties which arose in filling the capsule, unfortunately not all the Sr^{90} is at the radiating surface.

and a series of cases treated with this method were compared with another series in which beta rays from radon had been used. No demonstrable difference in the biologic effectiveness in the two sources could be demonstrated—efforts being made to approximate the dosages in the two groups. In the case of the Sr^{90} applicator, the treatment was applied in direct contact over a period of 60 seconds which gave a dose of approximately 325 roentgens. (As already noted, the Sr^{90} beta ray applicator emits 5.4 roentgens per second at the surface). All treatments have been given by the direct-contact technique since this is the only manner in which the actual dose to the tissue can be carefully regulated. The spray technique is believed to be inaccurate since the geometry (relationship of the radiating surface to the tissue to be irradiated) cannot be rigidly controlled.

The conditions which appear favorable for radiation are:

1. Superficial tumors

Small benign tumors, especially papillomas of the lids and conjunctiva respond very well to beta irradiation. Bowen's disease or intra-epithelial epitheliomas can be destroyed with beta rays without risk of deeper damage. Angiomas of the lids and conjunctiva in infants respond to beta radiation if treated early. With this type of lesion the response is generally quite prompt and the cosmetic result excellent. Usually one or two treatments are sufficient.

Pterygia, either true or of the pseudo variety, recurrent pterygia, and enlarged pinguecula all respond very satisfactorily to beta irradiation. Several treatments of 300 r each is usually all that is necessary to obliterate this type of lesion. Our usual course has been 300 r weekly for a total of 1,200 r.

2. Vernal conjunctivitis

Early cases of vernal conjunctivitis show an excellent therapeutic response to beta irradiation. In these early cases, the papillas consist of proliferating, young fibrous tissue, new vessels, and lymphoid cells which are all very radiosensitive.

The long-standing cases showing the typical cobblestone plaques with hyalin degeneration are, however, more resistant to irradiation and often must be removed first by excision. Beta radiation may then be applied to this area.

In applying the radiation, it must be remembered to give special attention to the upper edge of the tarsal cartilage, as it is these follicles that cause the most troublesome symptoms. We have used dosage totaling 1,200 r.

Patients with the limbal lesions usually are seen at an early stage and consequently the response to therapy is very satisfactory. Recurrences in both the limbal and palpebral types of vernal conjunctivitis have been greatly decreased by radiation therapy.

3. Anterior segment tuberculosis

The work of Woods has shown that anterior ocular tuberculosis is favorably treated in more than 50 percent of the cases observed. Recurrences are not decreased, but the irradiation appears to have a beneficial effect on the immediate attack. The limbal type of follicle hypertrophy with corneal infiltration that has an appearance similar to phlyctenule responds to irradiation with noticeable susceptibility. The mode of action is not known, but it may be due to a radiosensitivity of the lymphoid and giant cells which degenerate and are replaced by fibrous tissue.

4. Vascularization of the cornea

Beta irradiation is used both to prevent and also to obliterate corneal vascularization. It acts to inhibit the proliferation of capillary endothelium in newly forming vessels and infiltrating loops of vessels can be stopped short by beta radiation. Larger and well-established vessels can also be obliterated by beta radiation in greater amounts applied over the limbus. The radia-

tion induces an obliterative arteritis and resulting occlusion.

The dosage varies. We have administered radiation in courses, usually totaling 1,200 r in a period of one month. This may be repeated after an interval of 1 to 2 months.

Vascular obliteration by means of beta irradiation has proved favorable in the following circumstances:

a. After superficial keratectomy to prevent a revascularization of the corneal stroma. In these cases the irradiation should be started after the first 24 hours and should be applied at the limbus.

b. As a preliminary procedure to corneal transplantation when there are invading vessels in the cornea.

c. Following corneal transplantation when there is a possibility of vessels re-infiltrating the graft from the surrounding cornea.

d. In vascularized corneal leukomas that are associated with symptoms of irritability, photophobia, and lacrimation. Chemical burns of the cornea are often associated with this clinical picture and are greatly relieved by irradiation therapy.

5. Corneal ulcers

There is no need for irradiation therapy in acute pyogenic corneal ulcers. This treatment is unsuccessful and may be followed by perforation of the cornea.

Certain forms of chronic ulcer are known to heal with irradiation therapy applied to the limbal region directly adjacent to the ulceration. There are no contraindications to this and it should be tried in stubborn or slow-healing ulcers.

Summary

Under certain conditions the short range of beta particles in tissue is particularly useful in radiation therapy. This is true in the eye where it is important to protect the deeper structures such as the lens from deleterious radiation effect. No special therapeutic benefit can be attributed to the beta rays proper. Beneficial effects are the result of ionizing radiation and this effect can be produced as well by X rays. It is difficult, however, to prevent radiation to the deeper structures with the ordinarily available X irradiation.

In estimating dosage, the concept of ionization in tissue or energy absorbed in tissue has been presented. This is important in comparing the dosage of various beta-ray sources as well as the dosage of X rays.

Measurements of the Sr^{90} applicator which is described have been made in this fashion and the dosage is recorded in roentgens equivalent physical (rep).

The Sr^{90} applicator has several advantages. It requires calibration only once and need not be replenished, its half life being 25 years. It emits an energetic beta particle arising from the yttrium daughter (Y^{90}) which has adequate penetration for ordinary purposes. There are no accompanying gamma rays, providing added protection for the operator.

The clinical applications of Sr^{90} beta-ray applicator have proved satisfactory and compare well with the beta radiation administered with a radon beta-ray applicator. The usual conditions which include superficial tumors of the lids and conjunctiva, vernal conjunctivitis, anterior segment tuberculosis, vascularization of the cornea, and corneal ulcers have been treated.

University Hospitals (6).

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Discussion

Dr. H. M. Katzin (New York): I should like to ask Dr. Friedell two questions.

First of all, he tells us, as do radiologists always, that radiation from sources such as radioactive materials does the same things that X rays do, and the same effects can be accomplished with X rays as with radiation sources from radioactive materials. My question is this:

If you use electromagnetic energy to treat the superficial layers of the eye, the ionization that occurs locally, the speed or the energy with which the electron is dislodged in the tissue, depends upon the energy value of that electromagnetic wave. If you are going to use electromagnetic waves that will only penetrate superficially (to protect the lens), waves that will not penetrate more than four mm., which will be derived from something like a 10-K.V. source, then the secondary electrons that you get in the tissue will have relatively very little energy—a short path, and relatively less effectiveness. Can they be compared to the electrons that are delivered from radioactive materials to the same tissue, the same depths, by a source of electrons that are delivered at one third or two thirds the speed of light?

The second question is this: What experience have you had with your strontium applicator in irradiating the vessels that are deep in the limbus, vessels that lie, say, close to Descemet's membrane? Has the strontium applicator been as effective with those vessels as has radon?

Dr. Ludwig von Sallmann (New York): How is Sr^{90} distributed in the bulb? Is it distributed homogeneously or irregularly?

Dr. David Cogan (Boston): I would like to ask the author if he has any comments to make on possible undesirable late effects from beta radiation, genetic effects that might appear later, such as has occurred with X rays in the past?

Dr. H. L. Friedell (Cleveland): First of all I would like to reply to Dr. von Sallmann with regard to the distribution of the strontium in our bulb. Unfortunately we have not had as uniform distribution on the surface as we would like. We had hoped for homogeneous distribution but found by measurement that irregular distribution existed, with more Sr^{90} at the periphery.

Actually, an ideal way of distributing radiation would be to place a considerable quantity of the radioactive material at the periphery so that beneath the surface the dosage would be fairly uniform. The irregularities on the surface which are present in our bulb are not marked and we try to make up for this during irradiation by rotating the applicator and moving slightly. This improves the homogeneity of the distribution.

With regard to comparison of the radon bulb and strontium for treatment of deeper vessels, I prefer not go into this because our measurements with radon are not yet complete. By preliminary physical measurements we found that our strontium beta-ray applicator is as good as or actually superior to our radon applicator. From purely biologic observations it appears as if we can accomplish obliteration of the deeper vessels with the strontium bulb at least as well as with the radon bulb.

With superficial radiation, sufficient radiation may be administered in the depth by over-irradiating the surface. Unless accurate information is available on the absorption in tissue (depth dose) it is often difficult to compare biologically one type of radiation with another.

We have had difficulties in estimating the dosage from our radon beta-ray applicator. One of our technicians blows the glass bulb which is to contain the radon and the thickness of the bulb often depends upon who is blowing it and how hard, and so forth. We found discrepancies in the thickness of the bulb, and, since our measurements have been made on the basis of gamma-ray emission, we have found that bulbs of equal gamma

ray intensity have considerable variation in their beta-ray emission. We are now attempting to make all measurements by direct measurements of the beta rays themselves. An extrapolation chamber is being used for this purpose.

With regard to genetic effects; first of all in the case of the eye we are treating tissues that do not have great impact on the reproductive cells. You can produce genetic changes and mutations no matter what tissue you irradiate, the most important tissues, of course, being the basal cells of the gonads, but generally by the use of beta radiation as applied to the eye it is very difficult, I am sure, to produce any real effects that would be measurable in mutation-rate changes of the progeny. In the case of beat rays, very superficial radiation is applied to a very small area—radiation therefore limited to a minute fraction of the total cells.

With regard to Dr. Katzin's second question, it is important to point out that the energy of the electrons released by low-voltage X rays in general do not have energies comparable to the beta particles (high-speed electrons) arising from beta-ray emitting radioactive materials. However, as indicated in Figure 2, the variation of energy and range is not great and, therefore correspondingly, the density of ionization or ion pairs per unit path will also show only moderate variations.

It is well to remember that alpha particles may have a specific ionization (ionization density per unit path) which may be 500 to 1,000 times as great as energetic beta particles. Nevertheless, for equal dosage the increased biologic effect of alpha particle radiations as compared with beta radiation is represented by a factor varying from 1 to 20, and on the average is probably a factor of 6 or 7. Since the variation in the ion density with high- and low-voltage beta particles is much less extreme than in the case cited above, it will be reasonable to expect only moderate variations.

The difficulty which arises in comparing the biologic effects of high- and low-energy beta rays, and comparison of beta-ray effects with gamma-ray effects, concerns itself with the problem of making certain that comparisons are made on the basis of equal energy absorption.

BLASTOMYCOSIS OF THE CONJUNCTIVA*

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Conjunctival blastomycosis, a fungus infection of the conjunctiva, may involve one or both eyes. It is a comparatively rare disease. Gabrielides (1921) mentioned only three cases in his book on conjunctivitis. All three cases had an associated stomatitis.

One of the cases, reported by Billard in 1830, was that of a young girl with lesions involving the eye, the eyelids, and the mouth. The other two cases were mentioned by Pichler in 1895. In both of these two cases, one that of a baby and the other of a child, aged three years, there was pseudomembranous conjunctivitis, and, although the mouth was involved, the main lesions were in the cornea.

Pichler also mentions a case of conjunctivitis due to Penicillium glaucum in which the conjunctival lesion was green in color.

Case reports

Since these reports in the literature differ both clinically and microscopically from two

* From the Military Hospital. Presented before the Greek Ophthalmological Society, Athens, October, 1947.

Fig. 1 (Theodorides and Koutrolikos). *Case 1.* View of the infected right eye.

cases which came to our attention, we should like to report our cases in detail.

CASE 1

History. K. N., a soldier, aged 25 years, was admitted to the hospital on September 24, 1946, with the complaint that he had noticed two white spots in the right eye. There were no other presenting symptoms.

Eye findings. Vision was 10/10, O.U. The fundi were clear. There was no night blindness. In the right eye, at the 3-o'clock and the 9-o'clock positions (fig. 1), were white spots which had the appearance of freshly made soap suds. These spots would reform immediately after retraction. They did not stain with methylene blue. The use of yellow mercuric oxide (2 percent) seemed only to cause rapid reproduction of the fungus.

Fig. 3 (Theodorides and Koutrolikos). *Case 1.* Separation of the protoplasmic mass, with division of the chlamydospores (×225).

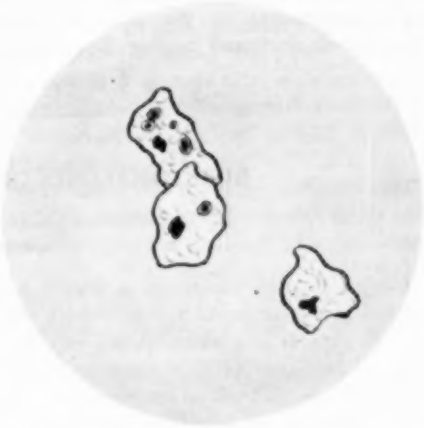

Fig. 4 (Theodorides and Koutrolikos). *Case 1.* Three epithelial cells of the conjunctiva, two having leishmaniform fungi (×250).

Fig. 2 (Theodorides and Koutrolikos). *Case 1.* Fresh smear (×450). Note the plasmoid shape of the fungus with filamentous extension and with two chlamydospores.

On October 9, 1946, the left eye in this same patient also became involved.

CASE 2

History. N. K., a 23-year-old soldier, was sent to us by his officer.

Eye findings. On October 22, 1946, vision in both eyes was normal. The fundi were

Fig. 5 (Theodorides and Koutrolikos). *Case 1.* Appearance of patient after cure.

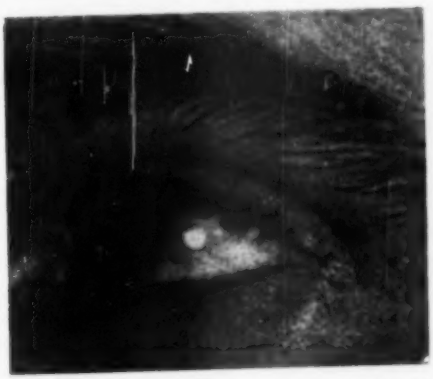

Fig. 6 (Theodorides and Koutrolikos). *Case 2.* Appearance of lesion in the left eye.

clear. There was no night blindness. Over the conjunctiva of the left eye, at about the 3-o'clock position (fig. 6), we observed two small spots, white in color and with all of the characteristics of the lesions present in Case 1.

DISCUSSION

Conjunctival blastomycosis is a chronic topical disease due to invasion of one or both eyes by a fungus of the genus, Blastomyces. Since inflammatory processes are seldom present, the evolution of the disease is not

Fig. 7 (Theodorides and Koutrolikos). *Case 2.* Fresh smear (×450). Plasmoid shaped fungus with spores.

Fig. 8 (Theodorides and Koutrolikos). *Case 2.* Appearance of the smear after two hours.

alarming. Characteristic are the one or two white spots which form at the corneoscleral limbus.

At onset, the infection shows no symptoms. As the invasion advances, however,

there is a foreign-body sensation, tearing, and photophobia.

The shapes of the spots differ and the size varies from pinpoint to that of a coffee bean. The fungus becomes implanted in the conjunctival epithelium and grows upward. Regrowth of a lesion after removal is almost immediate and is particularly rapid after the use of some medicinal substances. To illustrate; ordinarily, regrowth after removal occurs in from 90 to 120 seconds. After application of 2-percent yellow mercury, however, regrowth takes place in from 15 to 60 seconds. Under side light and with the binocular lens, the spots always resemble freshly made soap suds or the froth of beer.

The infection is rather stubborn, or was until we found a course of therapy to be discussed later. In our first case, it persisted for five and one-half months; in the second for 34 days.

Laboratory studies

Extensive studies were made of this fungus in fresh and dry preparations, in cultures, and in tests with experimental animals. From our experience, it is recommended that only studies of fresh smears are worth while. The results of our detailed microscopic study of fresh smears are shown in Figures 2, 3, 4, 7, and 8.

Cultures were made in Sabouraud's medium, in malt agar, in sour agar, and in Bierbaum agar, and all were negative except two. These two cultures were, no doubt, contaminated by an aerobic saprophyte. The animal tests were negative.

Diagnosis

Although the diagnosis in these two cases was established by laboratory demonstration of the fungus, it was necessary to differentiate the disease clinically from the spots of Bitot and from conditions due to vitamin-A deficiency. Clinically, too, conjunctival blastomycosis resembles the conjunctivitis due to the Penicillium glaucum which, however, produces a greenish lesion and is easily distinguished microscopically.

Therapy

Successful therapy in the first case was reached through the process of eliminating unsuccessful treatments. Vitamin A, 30,000 units in the form of fish oil, was tried first, without results. Neosalvarsan injections were given; again, no results. A course of potassium iodide therapy (8 gm. daily) also resulted in failure. Finally a solution of 2-percent silver nitrate was applied locally once a day for four days, and the condition cleared.

In the second case, a solution of 20-percent zinc sulfate was tried instead of the silver nitrate. Three applications effected a cure.

Conclusion

Blastomycosis is usually seen in the fall, for summer is the period of its invasion. It is a conditon most prevalent among agricultural workers and aged persons. Both of our cases were due to the same species of Blastomyces. Fresh smears are best for laboratory demonstration of this fungus, but dry smears will show numerous polymorphocellular, plasmoid, and filamentous figures with spores. The presence of leishmaniform endocytes also shows the parasitic nature of the fungus.

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BETA IRRADIATION*

An evaluation of a radium-D applicator for ophthalmic use

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Beta-radiation applicators already in ophthalmic use have certain inherent faults. Radium-element applicators, for example, are weakened by self-absorption and have prolonged treatment times. Radon applicators are difficult to obtain, usually, and they deteriorate rapidly, being consumed by half in less than four days. Both radium and radon applicators emit undesirable gamma radiation.

Radium D was chosen for the radioactive element in a new applicator developed by the Canadian Radium and Uranium Corporation because it is an almost pure beta emitter and has a half life of 22 years. The purpose of this study is to evaluate the radium-D applicator in terms of some of its fundamental radiobiologic properties and their practical implications.

Material and Methods

The *radium-D applicator* (D.140) used in this study had the following specifications:[1] the head containing the radioactive source, said to be radium D, had a circular contact surface 9.0 mm. in diameter, 5.6 mm. of which was the diameter of the active portion of the contact face, representing a radioactive area of 25 sq. mm. At manufacture, the same amount of radium D, or that amount which is calculated to produce approximately a 10 mc. output, was put into these applicators, and they were said to have a dose rate at contact of about 200 beta roentgens per minute. The manufacturer[2] stated that applicators containing twice the amount of radium D could be made if desired, but that the output would be increased only about 50 percent and would result in appromixately 15 mc. instead of 20, due to the plateau imposed by an increase in self-absorption within the applicator.

The radium D was covered at the contact surface by 0.05 mm. of aluminum foil. The applicator had interchangeable manual holders and a nonmanual arrangement having a short, metal rod which was held by a special clamp[3] attached to a lid speculum. This arrangement was used most often, since it was found to produce less dancing of the applicator and was better suited to the long treatment times used in some of the rabbit experiments.

Radon, the gaseous disintegration product of radium, was used for comparison with the radium D. The radon was sealed in glass capillary tubes which were partially embedded in wax in an applicator designed by Hughes.[4] This applicator was kidney-shaped; its treatment surface area was about 60 sq. mm., and its face was open, allowing near contact of the radon needles to the surface of the eye. The radon needles were about 7 to 8 mm. long, three in number usually, arranged parallel, and spaced at about one mm. to achieve as much uniformity as possible. The active area enclosed by the battery of needles was variable, but averaged about 25 sq. mm.

Data for the evaluation of the radium-D applicator were obtained by animal standardization, comparison with a radon applicator, and by physical observations.

Thirty-two rabbits, weighing between 4 and 6 pounds, usually gray or brindle colored, were used in the experiments. General anesthesia was obtained from intravenous nembutal. All rabbits were treated with-

* From the Department of Ophthalmology, University of Illinois School of Medicine. Presented at the 18th scientific session of the Association for Research in Ophthalmology, Inc., Philadelphia, June, 1949. This study was aided by a grant from the Council on Physical Medicine, American Medical Association.

TABLE 1

METHOD OF GRADING CORNEAL LESIONS
(After Hughes and Iliff)

Description	Maximum Severity	
Corneal Lesions		
Opacity (density × area)	4 × 4 = 16	
Edema	3	
Ulceration (depth)	4	
Vascularization (mm. area/20)	7	
Total (corneal lesions)		30
Extracorneal Lesions		
Discharge	3	
Hyperemia	2	
Chemosis	2	
Necrosis	2	
Iritis	3	
Total (extracorneal lesions)		12
Total (ocular score)		42

out proptosing the eyes, and all exposures were made with the applicators in contact with the cornea, without filtration.

Of 63 rabbits' eyes used, 31 were exposed to the radium-D applicator, 31 to the radon applicator, and one to a dummy radium-D applicator. Of the total number of rabbits, two were used for preliminary tolerance determinations, and nine were given exposures which were equal in the two eyes, but one eye of each animal was treated with Ra D while the opposite eye was given the same number of gram seconds of radon. By thus eliminating the variation in individual reactivity among rabbits, a factor which was found to be considerable in certain animals, it was possible to use the resulting comparison for the basis of the treatment of a series of rabbits receiving different dosages in opposite eyes.

For this series, 16 rabbits were used; each rabbit was treated with radium D in one eye, radon in the other, and dosages were calculated to produce lesions of approximately equal severity in the two eyes. The remaining rabbits were treated with varying dosages of radium D and radon, depending upon the need for material to establish more definite trends of the lesions for certain exposures.

Additional data were derived from clinical and pathologic observations, erythema exposures on human skin, physical observations using contact radiographs, and a Geiger-Müller counter.

Treatment dosages are expressed in the convenient notation of gram-seconds, calculated on the basis of the millicuries of radon or milligrams of radium in the applicator. Since one mc. represents that amount of radon which is in equilibrium with one mg. of radium, exposure time (sec.) for one gram-second = 1,000/mc. or mg. in the applicator.

Grading of lesions (table 1) in the rabbit cornea was based on the method used by Hughes and Iliff.[5] Corneal vascularization was given more weight (maximum 7) because of the dense pannus which developed, in some cases over the entire cornea. Otherwise only minor modifications were made.

RESULTS

PRELIMINARY DETERMINATION OF TOLERANCE TO RADIUM-D APPLICATOR

Four rabbit eyes were exposed to irradiation of 10, 20, 30, and 40 gram-seconds at contact with the radium-D applicator, and the first corneal changes, perceptible grossly, occurred somewhere between the 20 and 30 gram-second exposures. Subsequent irradiations indicated that the critical dose for a consistent, minimal lesion was approximately 25 gram-seconds, or 41 minutes, with this radium-D applicator of 10 millicuries. This lesion had a corneal score of about three percent of the maximum possible.

COMPARISON OF CORNEAL LESIONS PRODUCED BY RADIUM-D AND RADON

When the results of exposure to radium D and radon were compared on an equal gram-second basis (table 2), it was observed that the lesions produced by radon were more severe following lower doses. A minimal corneal lesion appeared after 10 gram-seconds of radon; whereas, a 25 gram-sec-

TABLE 2

COMPARISON OF RABBIT CORNEAL LESIONS PRODUCED BY EQUAL GRAM-SECOND EXPOSURES TO RADIUM-D AND RADON APPLICATORS

Dose	Radium D			Radon		
Gm. Sec.	No. Eyes	Lesion %*	S.E.†	No. Eyes	Lesion %*	S.E.†
10	2	0	—	4	2	± 0.7
15	2	0	—	4	12	± 8.0
20	3	0	—	2	22	± 5.2
25	3	2.6	± 0.69	5	30	± 5.4
30	6	9	± 1.5	3	50	± 6.3
40	3	11.5	± 1.6	3	56	± 4.5
50	0	—	—	3	80	±14.0
60	4	21	± 4.5	0	—	—
80	3	49	±12.0	0	—	—

* Mean of maximum lesions.
† S.E. = Standard error of the mean.

onds exposure was required by the radium-D applicator. The most severe radium-D lesion (49 percent ±12), requiring 80 gram-seconds, was equalled (50 percent ±6.3) by 30 gram seconds with the radon applicator.

These data were compared to determine which doses with each applicator produced corneal lesions of equal severity (fig. 1). The ratio of radon: radium D for equa'ly effective doses was found to be approximately 2:5, with a range of variability from 1:4 to 3:5 due to multiple, small factors.

This indicates that the radium-D applicator used is about 40 percent effective (with an effective potency of about four mc.) in producing irradiation lesions of the rabbit cornea on the basis of its millicurie rating, as compared with radon needles applied at near contact.

Course of the lesions (fig. 2). The ra-

TABLE 3

COMPARISON OF ULCERATIONS OF CORNEA AFTER IRRADIATION WITH RADIUM D AND RADON

	Rabbit Eye (number)	Gram-Second (dose)	Ulcer Depth (grade)	Interval of Ulceration (days)	Condition of Ulcer at Last Reading
Ra D	13L	60	1	35–51	Healed
	15R	80	4−	10–38	Healed
	18R	80	(+−)	18–21	Healed
	20R	60	(+−)	3–8	Healed
	21R	60	3	10–24	Grade 1; improving
	25R	60	1	4–14	Grade (+−); improving
	Average	66	1.5+ (40%)	10–28	Good
Radon	3R	25	1+	26th–46th Day	Healed
	6R	25	4−	31–45	Died at 4−
	6L	25	3	31–45	Died at 3
	7L	50	4	12–49	Perforation on 49th day with subsequent panophthalmitis.
	8L	30	2+	53–63	Grade 1; improving
	9R	20	4−	32–63	4−
	11L	15	1	25–53	Healed
	12L	40	1	12–53	Healed
	Average	28	3+ (80%)	28–52	Fair
	S.E. (t)	6.2	2.1		

dium-D and radon lesions of the rabbit eyes, after relatively large doses of beta irradiation, differed not only in the severity of the lesions produced, but also in their course of development, making direct comparisons somewhat more difficult. The irradiation lesions of both applicators were characterized

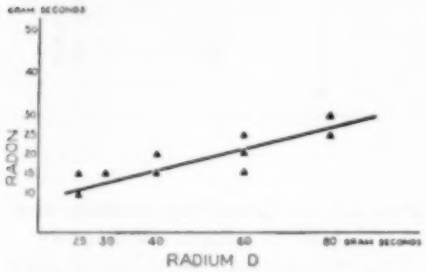

Fig. 1 (Wilson). Comparison of equally effective doses of radon and radium D. Maximum lesions produced by the dosages indicated are not significantly different on the basis of the standard error of differences of their means.

by moderately rapid development during the first two weeks after irradiation. By this time, the radium-D lesions had reached their maximum and had begun to subside. The radon lesion curve, however, after two weeks, continued to rise but more slowly than before, requiring 3 to 6 weeks for full development of lesions after exposures of 15 to 25 gram-seconds. After 30 gram-seconds, or more, some of the corneal lesions progressed for two months.

The incidence of corneal ulceration (table 3) was less (6:8) in the eyes exposed to the radium-D plaque than those exposed to radon. On the average, more than twice the dose of radium D was required to produce ulcers, these doses conforming closely with the approximate dose ratio of 2:5 found previously. Radium-D ulceration averaged only one half that caused by radon, correspond-

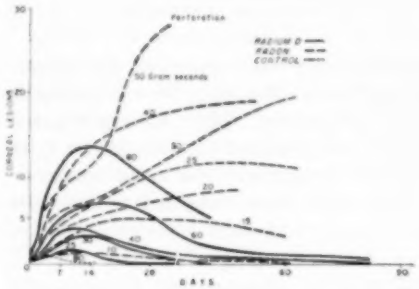

Fig. 2 (Wilson). Graded course of the lesions produced in rabbit corneas by beta irradiation with unfiltered radium D and radon of various doses.

ing to the difference in beta energies (table 4) of the two radiation sources.

Similar to the corneal lesions in general, the ulcers resulting from radium D de-

TABLE 4

COMPARISON OF RADIUM-D, RADON, AND RADIUM APPLICATORS

Radioactive Source	Radium D	Radon	Radium
Applicator Strength	10 mc.	100 mc. (e.g.)	50 mg.
Availability	Good	Poor	Good
Approximate cost	$1,000	$150	$1,200
Half-life	22 yrs.	3.83 days	1,590 yrs.
Geometry (Loading	Uniform	Nearly uniform	Uniform
Geometry (Dose Rate	Constant	Slightly variable	Constant
Dose time for 4 gm.-sec. effect	16+ min.	40 sec.	8 min.
Effective potency	4 mc.	100 mc.	8 mc.
Effective potency compared with radon	1:3−	1:1	1:6
Gamma exposure at 1 cm. (For 4 gm.-sec. effect)	0.16 *r*	10 r	60 r
Beta energy (Average Mev*)	Ra D (too low) Ra E 0.34	Ra B 0.23 Ra C 0.65	Ra B 0.23 Ra C 0.65
Clinical application	Surface	Superficial	Superficial

* Mev = million electron volts.

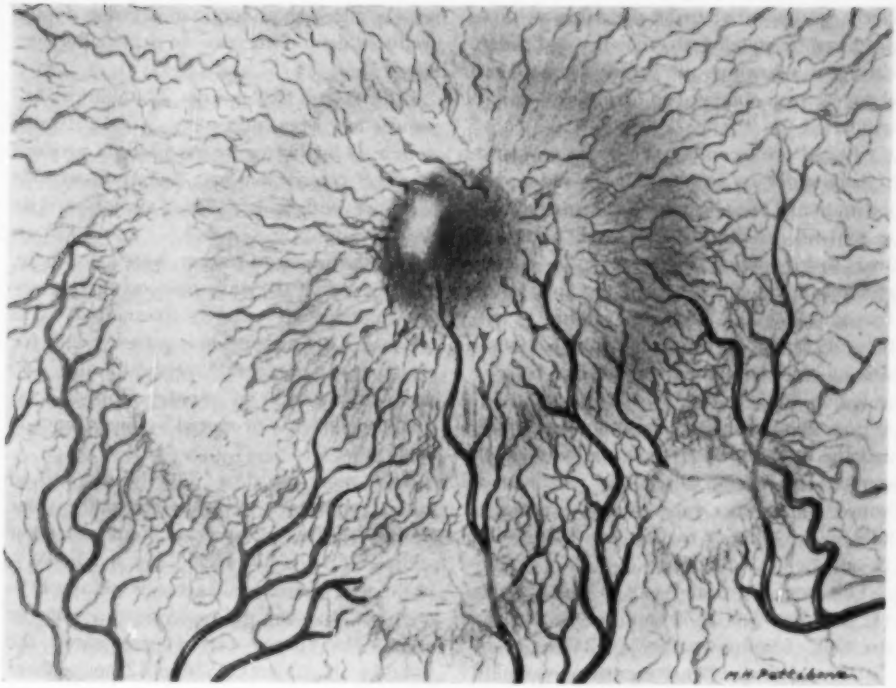

Fig. 3 (Wilson). Vascularizing keratitis of unknown etiology. Typical response in areas treated three weeks previously with unfiltered radon (two gram-seconds at the 6-o'clock position; three gram-seconds at the 8-o'clock position) and radium D (six gram-seconds at the 4-o'clock position), as seen with the low-power biomicroscope.

veloped sooner and healed earlier, being present on the average during the period from the 10th to the 28th day. The average interval during which corneal ulcers were present from radon was later, from the 28th to the 52nd day after irradiation.

Perforation of the cornea did not occur in this series until a dose of 50 gram-seconds was given; then it occurred in only one of the eyes receiving this amount of radon exposure. Perforation did not occur in any of the rabbits' eyes exposed to the radium-D applicator, in spite of dosages as high as 80 gram-seconds in three eyes. Such an exposure with the radium-D applicator required continuous contact of the applicator on the cornea for two hours and 12 minutes. The time for an equivalent exposure with radon depends on the output of the applicator, but for an applicator of, say, 100 mc. (and it will frequently exceed this), the dosage time for 80 gram-seconds is a little over 13 minutes. As a control, a dummy applicator, identical to the radium-D applicator but containing no radium D, was applied in the same manner for the same period of time (two hours and 12 minutes). The lesion (fig. 2) produced by this amount of mechanical trauma consisted of a Grade 1 superficial corneal edema which gradually disappeared within a week.

In the lower dosages of radium D the extracorneal response was usually imperceptible, but as the dose increased to a level sufficient to produce corneal changes, the extracorneal redness, chemosis, necrosis, and

discharge appeared to be the same as those produced by equally effective doses of radon. Except following perforation, no lens changes were observed in any of the rabbits irradiated.

Clinical observations. The routine source of beta radiation in our clinic is radon, and the radium-D applicator has been used only in patients presenting previously untreated areas large enough and suitable for a comparison of the effects of the two applicators. In comparing the effects of radium D with those of radon, the two applicators were used side-by-side on patients receiving beta irradiation for a variety of ocular conditions.

Fourteen such comparisons were made, and the dosages which gave the most nearly comparable results were those which maintained the dosage ratio found experimentally, approximately two radon : five radium D, or roughly, 1:3.

This was illustrated (fig. 3) in a patient (C. L., No. 326 557) with a vascularizing keratitis of unknown etiology, having evenly distributed and extensive corneal vascularization. Treatment was begun in three limbal areas with two gram-seconds radon, three gram-seconds radon, and six gram-seconds radium D. Three weeks later the findings were typical of these dosages.

The three gram-seconds radon area (8-o'clock position) was largest and showed definite irregularity of caliber and obliteration of deeper conjunctival and limbal vessels as well as superficial vessel fragmentation and ischemia.

The areas treated with two gram-seconds radon (6-o'clock position) and six gram-seconds radium D (4-o'clock position) were almost identical to each other, illustrating the comparative effects of a 1:3 dose ratio. These areas were about three mm. in size, slightly edematous and pale, with definite fragmentation of the superficial vessels but only occasional and slight irregularity of the deeper conjunctival vessels.

Increasing the dose of radium D has increased very little the effect on the deeper vessels, although an increase in radon dosage produces definite increase in depth effectiveness.

Iliff[6] stated that nearly 22 minutes' exposure has been necessary, with a 10-mc. radium-D applicator he has used, to produce an effect comparable to a five gram-seconds exposure with radon. This, also, is a dose ratio of approximately 2:5.

For the applicators that were used here, it appears that the dose ratio, averaging approximately two radon = five radium D, in producing lesions in rabbit corneas, will, for most patients, hold therapeutically also. Occasionally because of a patient's poor fixation, less effect is produced by the radium-D applicator.

Skin erythema dose. The radium-D and radon applicators were applied to the volar surface of the forearms of four volunteer subjects (A. S., W. H., R. K., and F. W.), in dosages of two gram-seconds radium D to one arm, and one gram-second radon to the other. The effects were approximately the same in all subjects. Within 12 hours there was a first degree erythema in both areas; this was very little more than perceptible redness in the radon area, but was much more intense in the radium-D area. Subsequent exposure with a radium-D dose reduced to one gram-second in one subject produced an effect similar to one gram-second radon.

Histopathology. Changes observed in sections of enucleated rabbit eyes after irradiation with the radium-D and radon applicators have revealed no significant qualitative differences. The histologic changes included by Hughes and Iliff[5] in describing the effects of beta irradiation on the rabbit's eye (epithelial disorganization, loss of stroma cells, stromal edema, endothelial desquamation, and secondary iritis) were found common to both radium-D and radon-treated animals when similarly scored eyes were examined. As an index of the comparative depths and extent of effects of the irradiation, the histologic changes were often less

informing than the gross observation of corneal lesions.

Physical observations. Contact radiographs made on dental film, using 1.8-mm. lead—more than enough to filter the beta rays—resulted in marked blackening of the film after 30 gram-seconds radon, indicating the presence of the more penetrating radiations, in this case gamma rays. Using the radium-D applicator and covering half of the dental film with 1.8-mm. lead, the film was exposed for 30 gram-seconds, and no blackening occurred on the half covered by the lead, indicating the absence of a sufficient amount of penetrating photon activity to affect the emulsion.

Contact radiographs made by momentary exposures of the dental X-ray films revealed a uniform loading of the radium-D applicator and a uniform spread of the radiation from the radon applicator.

Through the coöperation of Dr. John Laughlin, the radium-D applicator was subjected to a Geiger-Müller counter, after first removing the influence of the beta rays. This was accomplished by interposing a magnetic field between the applicator and the counter to cause deflection of the electrons (beta particles) without influencing the X rays or gamma rays. With this arrangement the instrument indicated definite activity, as it continued to do also when four mm. of lead was placed over the face of the applicator. The Geiger tube responds to ionizing radiations and does not differentiate between them. The source of this activity, then, could have been either secondary X rays produced by the beta particles, or gamma radiation. No attempt was made to calculate the magnitude of this radiation.

Comment

The approximate dosage ratio of two radon = five radium D, found for the averages of corneal lesions produced by the applicators used, is explained by several factors, some of which, like scatter, are probably unassessable. Comparative depth-dose figures have not been published, to my knowledge, but a partial explanation can be expected from this information when it becomes available. That the electromagnetic radiations (gamma and/or X rays), present in much greater amounts in the radon applicator, contribute significantly to the dose ratio seems doubtful, since relatively little is absorbed at the depth levels concerned here. Differences in the output of the radium-D applicators could, if lower, contribute to the explanation of the dose ratio found here.

Self-absorption in the radium-D applicator may be of considerable importance. The difference in size of the two applicators, which is not great when the active areas are considered, is therefore probably a small factor, but, as pointed out by Evans,[12] the difference in disintegration schemes of radium D and radon permit a partial explanation of their unequal potency. The decay of both radium B and radium C of radon produces beta emission, while the beta emanation from radium E, only, is of significance in the radium-D applicator.

The dosage ratio found here means a much prolonged radium-D treatment time in the clinic.

Obviously, many of the large doses of radiation used in these rabbit experiments would never be used clinically, but 60 gram-seconds radium D (requiring one hour and 40 minutes) can be applied to the eye of a rabbit under general anesthesia probably with very little more mechanical difficulty than treating a patient's eye with six gram-seconds, since the patient must hold himself quiet and his eye fixed for the calculated 10 minutes.

Moreover, if vessels are to be eliminated from vascularizing lesions, the results clinically and experimentally, with this applicator at least, indicate that a dose of six gram-seconds is not enough, except for the most superficial vessels, and in some instances (subsurface lesions, larger vessels, or poor ocular fixation), this dose will even have to be doubled, although it should be re-

membered that increasing the radium-D exposure, in order to gain depth effectiveness, increases the hazard of caustic effect at the surface. Accurate dosage requires steady fixation, which is difficult even for the most cooperative patient for 10 to 20 minutes.

The incidence of relatively superficial corneal ulcers in those rabbit eyes treated with larger doses of radium D, the rapid regeneration of the corneal lesions produced indicating less stromal damage, and the relatively low erythema dose for human skin, are evidence of superficial absorption.

Radium D, which gives off only a very soft beta radiation of quality even less penetrating than alpha particles and which can therefore be disregarded, owes its effective beta radiation to radium E,[7] one of its disintegration products. The beta particles of radium E, and therefore of the radium-D applicator, have only a little more than one half the average energy that the beta particles of radium C have (table 4). The lower the energy of the radiation, the less the penetration; and the dosages must be increased to produce deeper effects. At the same time, there is more energy absorption taking place at the surface and, therefore, more superficial damage. This means that radium or radon are theoretically less caustic superficially than radium D when used in equally effective dosages for subsurface conditions.

Moreover, vascularizing lesions of the cornea constitute one of the most common indications for beta irradiation in ophthalmology, and the beta radiation which has been used in the past, from radon and radium sources, has been practically ineffective in eliminating deep vascularization of cornea.

As pointed out, the average energy of the beta particles of radium D is even less and is, therefore, not the beta source of choice for more deeply placed vessels or any lesions of comparable or greater depth. In this regard, the accelerated electrons in the high-energy beams of the betatron provide therapeutic promise for the future. Control over the energy of these particles controls their depth of penetration. Perhaps, also, one or more of the artificially radioactive isotopes can provide a source of beta radiation of sufficient energy, half life, and dose rate to be useful in this regard.

That there is no qualitative difference in the histopathology of the lesions of radium D and radon is to be expected, since there is no significant difference in the lesions or biologic effects[8] produced by various types of radiation, and changes due to X ray, radium, radon (and even heat in some instances) are fundamentally destructive and alike. The differences in clinical response to radiation depend on area per unit of dose, the quality of the radiation, the time, and sensitivity (depending on absorption coefficient and nature) of the tissue being irradiated. Radiation energy produces its effects only on tissues which absorb it. If the particle is small and its energy high, considerable penetration may occur before absorption becomes significant.

The question of whether the photon activity indicated by the Geiger-Müller counter is due to gamma radiation or X rays is of more interest to the nuclear physicist than to the ophthalmologist who is probably interested more in the quantity of this radiation than its ultimate source. Authorities in this field did not appear to be in agreement, and the disintegrations given by some, like Glasser, and others,[9] and Segré,[10] included gamma emanation for radium D, while others, like Mattauch and Fluegge,[11] omitted it.

Evans[12] stated that this is the activity of Bremsstrahlung which are the X rays formed continuously from the absorption of electron energy as beta particles bombard the backing material in the applicator. He measured this radiation and found its magnitude per millicurie to be approximately the same as that produced by 0.007 mg. of

radium, which is of such low order that radium D is to be considered an almost pure beta emitter.

A consideration of the fundamental qualities of the radium-D applicator for ophthalmic use is summarized and compared with other applicators in Table 4. The radium-D applicator has a relatively constant output, uniform loading, a half life of 22 years, availability, and low photon activity, being an almost pure beta emitter. In this last respect only does it appear to be better than a radium applicator, like Iliff's,[12] which has the other advantages plus harder beta radiations, a half life of almost 1,600 years, and is cheaper per millicurie. Iliff[6] stated that 10 minutes' exposure with this (Iliff) applicator, containing 50 mg. radium, will produce about the same effect as five gram-seconds radon. This applicator, therefore, has only about an eight mc. effective beta radiation from its 50-mg. load; the 10-mc. load in the radium-D applicator is reduced to an effective emission of about four mc.

In terms of gamma-ray exposure, 10 minutes with 50 mg. radium (for a five gram-second effect) is actually a dose of 30 gram-seconds, and since one mg. radium emits in one hour about nine gamma r at one cm. distance, the gamma-ray exposure in this instance amounts to approximately 75 gamma r at one cm. The gamma emanation from the radium-D applicator is roughly 1/350 of this.

Compared with a radon applicator, the output of the radium-D applicator is almost constant; whereas, the geometry of the radon applicator changes with every loading so that there is variation in output. Radium D also has much less photon activity than radon (or radium), but the importance of this should not be over-stressed, since gamma radiation from radium and radon ophthalmic applicators has not been troublesome in the doses ordinarily employed.

Radium D has a much longer half life (22 years) than radon (3.82 days) and is generally much more readily available. Physical measurements of dose rate and depth dose of the radium-D applicator are not standardized.

The beta particles emanating from the radium-D applicator are softer than those from radon or radium applicators, and this is a disadvantage in treating a number of ocular conditions amenable to beta irradiation. The greatest disadvantage of the radium-D applicator is its low output, 10 mc., which is effectively even lower (about four mc.) when compared with a radon applicator on an equal gram-second basis. Further clinical studies are necessary to demonstrate the exact application of these fundamental qualities to individual ophthalmic problems.

Conclusion

The radium-D applicator (D. 140) has three important fundamental qualities to consider:

1. Low photon activity, an advantage, since it assures an almost pure beta ray emission.

2. Low energy beta emission, a disadvantage, since it means softer, less penetrating beta irradiation.

3. Low output, a disadvantage, because it necessitates a prolonged treatment time.

Although the radium-D applicator has certain desirable features, it possesses disadvantages which restrict its usefulness in ophthalmology.

1700 Guadalupe (1).

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Discussion

Dr. Arthur Alexander Knapp (New York): I am wondering if Dr. Wilson has made studies of the intraocular pressure tension before and after treatment. If so, I think it might be interesting to hear about his findings.

Dr. H. M. Katzin (New York): We have been working with an ordinary radium and a radium-D applicator in both clinical and experimental ways for several years, and we had experiences that check exactly with those of Dr. Wilson, except for this: We thought the radium-D applicator showed more promise, and we asked the radium company to make us one with 20 millicuries. With 20 millicuries an effective dose can be delivered in about six minutes and, although it does not penetrate deeply enough to affect the deep vessels that are sometimes important to reach, it does serve most purposes very nicely.

I expect it will be displaced very soon by strontium, but up until now we have had very good clinical results with it, and have used it for everything except the deepest vessels; those cases were sent to Baltimore for radon treatment.

Dr. H. L. Friedell (Cleveland): I would like to ask Dr. Wilson about the comparative radiating surfaces of the radium-D and radon applicators.

Dr. Ludwig von Sallmann (New York): I would like to ask how good the contact is between the radon applicator and the curved surface of the eye.

Dr. Fred M. Wilson (closing): In reference to Dr. Knapp's question concerning the effects on intraocular pressure, I am sorry that I am unable to answer that question, since tonometric determinations were not made on the animals used in this study.

I wish to thank Dr. Katzin for his remarks. A representative of the company also informed me in a personal communication that they could make a 20-millicurie applicator but that because of the increased self-absorption imposing a plateau, only about 50 percent of the increase in millicurie rating could be obtained as effective dosage; that is, it would have only about one and one half, instead of twice, the effectiveness of the 10-mc. applicator.

Dr. Friedell asked about the comparative surface areas of the two applicators. Although the applicators differ greatly in size, their active areas are not greatly different. The 25-sq.-mm. face of the radium-D applicator is comparable with the radioactive area enclosed by the battery of radon needles in the radon applicator, which, although somewhat variable, averages about 25 sq. mm.

The question about contact of the radon applicator with the surface being treated was asked by Dr. von Sallmann. This was variable with each loading because of the slight differences in the distances between the plane of the radon needles and the surface being treated. It was variable, however, within a very short distance, since it was endeavored to obtain as close an approximation of the radon needles as possible, without actual contact, to the surface being treated.

THE EFFECT OF LOW-VOLTAGE ROENTGEN RAYS ON THE NORMAL AND VASCULARIZED CORNEA OF THE RABBIT*

A PRELIMINARY REPORT ON THE PHILIPS MACHINE

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I. INTRODUCTION

This paper presents the results of investigations undertaken to determine the effect of low-voltage roentgen irradiation upon normal and vascularized rabbits' corneas, as well as supplementary clinical observations. During recent years, great interest has been aroused in the value of various types of superficial irradiation in preventing or destroying corneal vascularization. Other conditions involving the anterior segment of the eye have been benefited by the effects of this type of irradiation, among which are recurrent pterygia, vernal conjunctivitis, and certain superficial ocular tumors. The recently stimulated interest in irradiation of this portion of the eye has largely been due to the contributions of such workers as Ruedemann and Glasser,[1] Hughes and Iliff,[2] and others, and to the growth of the field of corneal surgery. Rather extensive experimental studies have been carried out in the past using beta irradiation. Little such work has been done with low-voltage roentgen rays of comparable penetration, although many workers claim clinical results similar to those obtained from beta irradiation.

The present studies were undertaken with a twofold purpose. First, to determine the effects, both beneficial and injurious, of low-voltage roentgen rays when applied to the eye under controlled laboratory conditions. Second, to determine whether or not X ray might be a satisfactory substitute for beta irradiation. If satisfactory, certain advantages would result. At present, beta irradiation, which is customarily furnished by radon, is practical only in those locations where a radon plant is available as a source.

X ray, on the other hand, is more universally available. Most adequately equipped roentgen departments have low-voltage therapy machines. One of these is the Philips contact therapy apparatus. Its cost is not excessive, being approximately $3,000. An alternative to either radon or X ray is a radium-D applicator, but this necessitates an outlay of about $1,000 for equipment which is of value only in the treatment of ocular conditions. The Philips tube, on the other hand, is extensively used for a wide variety of dermatologic conditions as well as the treatment of malignancies of the skin and oral cavity. Because of its all-around usefulness and availability, this was the type of machine used in all of our experiments and for our clinical work.

II. DESCRIPTION OF THE PHILIPS MACHINE

The Philips machine is ordinarily operated at 44 K.V. It is constructed in such a way that it can be used for ocular therapy without a filter. The tube is held in contact with the tissue being treated and, because of this short skin target distance and the negligible inherent filtration, the rays delivered have an extremely small depth of penetration. Used in this manner, a dosage rate of 4,400 r per minute is obtained, allowing an ordinary treatment to be given in 3 to 4 seconds. The tube is easy to posi-

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tion and maintain in place. In principle, therefore, the less the filter and the shorter the distance between the tissue and the tube, the less the penetration into the tissues.

The curve in Figure 1 demonstrates the

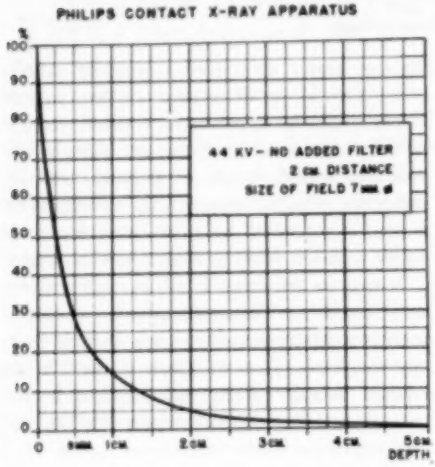

Fig. 1 (Scheie, *et al.*). The curve demonstrates the rapidity with which the dosage rate falls with the depth of the tissue.

rapidity with which the dosage rate falls with the depth of the tissue. A glance at the curve reveals that approximately 70 percent of these soft X rays from the Philips tube are absorbed by the first five mm. of tissue. At a depth of 10 mm., 84 percent of the dosage will have been absorbed. The amount of irradiation reaching any portion of the eyeball following application of the tube to its anterior surface can be calculated from this curve. We can say, therefore, that of 100 r delivered to the surface of the cornea, only 36 r reach the anterior surface of the lens, a depth of approximately four mm.

The relative penetration into the eye of roentgen rays of various kilovoltages and of beta rays can be shown graphically (fig. 2). Beta rays are given off from many natural and artificial radioactive substances. The energy of a given type of beta ray, and consequently its depth of penetration into tissues, varies according to its source. Blomfield and Spiers[3] (1946) made dose measurements on beta rays from a radium plaque by ionization methods and investigated other physical aspects of their penetration into tissue. As shown in the chart, the penetration of beta rays into the eye is considerably less than the Philips tube. However, a newer X-ray machine, the Bracke-Seib apparatus, is now available which ordinarily is operated at from 10 to 50 K.V. The X rays from this machine have even less penetrating qualities than beta rays when operated at the lower kilovoltage. Work is now in progress to determine the effectiveness of this machine for ocular use.

The Philips contact-therapy machine (fig. 3) employed for the present studies is

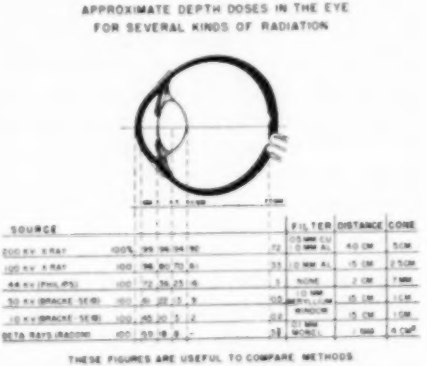

Fig. 2 (Scheie, *et al.*). The relative penetration into the eye of roentgen rays of various kilovoltages and of beta rays.

always used with a series of cones which fit over the end of the tube. These cones have different sized apertures (fig. 4) varying from 5 to 15 mm. in diameter through which the rays pass. The diameter of the cone aperture determines the size of the area which will be treated. Other variable factors in using the Philips apparatus for ocular therapy are the size of the dosage to be given, and the time interval between dosages.

III. Historical review

Since shortly after the discovery of roentgen rays in 1895, their effect upon ocular tissues has been of great interest to ophthalmologists and radiologists alike. Extensive experimental work, largely with harder, more penetrating rays, has been done in the past and numerous clinical reports have been recorded in the literature.

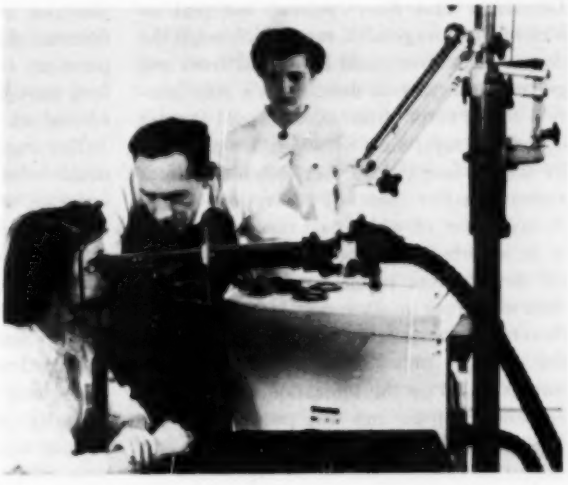

Fig. 3 (Scheie, *et al.*). The Philips contact-therapy machine. It is always employed with a series of cones which fit over the end of the tube. See Figure 4.

The earliest observations on the effects of roentgen rays on the eye were the inflammation of the eyelids and the conjunctiva which followed whole body irradiation to animals. It has been known for a long time that the eye of the fetus and the newborn animal, especially the crystalline lens, is very radiosensitive.

In 1905 and 1906, von Hippel[4, 5] showed that irradiation of the pregnant uterus of rabbits caused developmental anomalies of the eye structures and degenerative changes in the lens. Later, other workers (Tribondeau and Recamier,[6] 1905; Belley,[7] 1907; and Bossuet,[8] 1909) demonstrated that irradiation of the eyes of newborn and young growing animals produced marked changes and retardation of development in all the elements of the eye. The younger the animal, the greater was the retardation and injurious effect. Vacuolar degeneration of the crystalline lens and subsequent cataract formation were observed by all of these investigators following irradiation of the eyes of rapidly growing animals. This falls in line with the known susceptibility of young and rapidly growing cells to irradiation.

The range of radiosensitivity of the various structures of the eye, as reported in the literature, has varied widely with different investigators largely because their unit

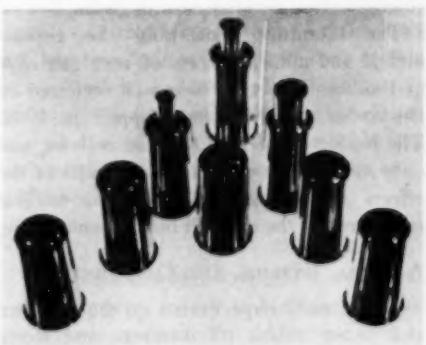

Fig. 4 (Scheie, *et al.*). Cones for Philips machine have different sized apertures varying from 5 to 15 mm. in diameter through which the rays pass.

of measurement of roentgen rays was entirely unreliable. The doses described in the various early reports were largely on the basis of skin erythema doses (S.E.D.), or epilation dose, both highly inaccurate units. Leinfelder and Kerr[9] pointed out that no idea of the dosage of X rays which reach the deeper structures could be gained from any given skin erythema dose. Such a skin reaction might result from a very small amount of soft X rays, most of which are absorbed by the surface tissues, but would require a rather massive dose of short or "hard" X rays, most of which pass through the skin to be absorbed by deeper structures. Technical details were often not given. Reliable data which can be accurately interpreted was therefore not available until the adoption of the roentgen unit (r unit) in 1929. The r unit is based on the ionization of one cubic centimeter of air and was proposed by the International Congress of Radiology as a universal measurement of roentgen rays.

The clinical reports are even more difficult to evaluate. This is further complicated by the fact that often the injury appeared years after the irradiation, which may have been given at another institution, or may even have resulted from other causes. Most of the cases concerned the irradiation of malignancies about the eye, or in eyes that already showed considerable pathologic or senile change before irradiation was given.

The literature concerning the experimental and clinical effects of roentgen rays and radium on the eye was well reviewed by Desjardin[10] in 1931 and Poppe[11] in 1942. The reader is referred to these reviews, and only some of the experimental results of the effects of roentgen rays on the various structures of the eye will be mentioned here.

A. Cilia, Eyelids, and Conjunctiva

In the early experiments on the newborn and young rabbit (Tribondeau and Recamier,[6] Belley,[7] Bossuet,[8] von Hippel,[8] and others) the first changes noted after sufficient doses of roentgen rays were given were loss of hair and cilia, and inflammation of the conjunctiva and eyelids. From 1 to 3 weeks after irradiation of the eyes, the cilia began to fall out. A few days later the conjunctiva became inflamed and showed a mucous discharge, which became frankly purulent if the irradiation was carried on long enough. The eyelids frequently became edematous and inflamed.

The range of sensitivity of the various ocular elements in adult animals and the order of sensitivity varied widely with different investigators. In 1904, Birch-Hirschfeld[12] irradiated eyes of adult rabbits sufficiently long to cause a severe conjunctivitis, and on histologic examination found degenerative changes of the endothelial lining of the blood vessels, thickening of the vascular coats, and narrowing of the lumen. The majority of the reports on adult animals seemed to establish the fact that the radiosensitivity of the conjunctiva and the lids was slightly greater than the surrounding skin.

Hunt,[13] in 1947, treated malignancies of the eyelid with roentgen rays and noted edema of the conjunctiva and lids in a few hours after treatment, followed by a mucopurulent discharge in 5 to 7 days. The eyelashes were lost in 10 to 20 days, but the corneas showed remarkably little reaction. Hunt found that conjunctivitis preceded epidermitis of the skin by about five days. Martin and Reese,[14] in 1936, treated retinal gliomas with large doses of roentgen rays in divided doses over a period of many months, and found that the conjunctiva tolerates the radiation better than the skin when given in this manner.

B. Cornea

From many experiments, the cornea has been shown to be definitely more resistant than the conjunctiva and lids. Changes described by many investigators on both young and adult rabbits, and clinically (Chalu-

pecky,[15] 1897; Tribondeau and Recamier,[6] 1905; Belley,[7] 1907; Rados and Schinz,[16] 1922; Jacoby,[17] 1924; Leinfelder and Kerr,[9] 1936; Desjardin,[18] 1938; Foy,[19] 1939; Hunt,[13] 1947, and others) vary from loss of luster to actual ulceration. Often, the only change was mere dullness which disappeared in a few days.

Keratitis appeared later and disappeared sooner than did the conjunctivitis. Animal experiments in which large single doses of irradiation were given, or fractionated doses over a long period of time, demonstrated ulceration or actual destruction of the cornea (Rados and Schinz,[16] 1922; Jacoby,[17] 1924; and Rohrschneider,[20] 1929).

Chalupecky,[15] in 1897, was the first to study the effect of roentgen rays on the animal eye. He described the microscopic features of the cornea in a heavily irradiated rabbit's eye as irregular degeneration, destruction, and thinning of the corneal epithelium except around the limbus. He also recorded changes in the palpebras, cilia, and iris, but none in the lens.

Jacoby,[17] in 1924, described the microscopic features of the cornea following heavy irradiation as degeneration and thinning of the epithelium to 1 or 2 layers of cells except around the limbus. Vacuolization of the cytoplasm and degeneration of the nuclei occurred. There was leukocytic infiltration around the vessels near the limbus.

Rohrschneider's work, in 1929, is interesting because it was carried out after great improvements in technical methods and dosimetry. Large doses of roentgen rays produced epithelial injury, followed by interstitial keratitis and vascularization. With still larger doses, ulceration and perforation developed. Rohrschneider[20] (1929), Poppe[11] (1942), and many other workers noticed the great regenerative ability of the cornea, as well as the conjunctiva, following exposure to roentgen rays.

Martin and Reese[14] (1936) described corneal changes that occurred in the course of the irradiation of retinal gliomas. It began as a stippling of the corneal surface due to innumerable punctate areas which stained with fluorescein. The appearance was that of a superficial keratitis. In a later report[21] (1942) on the same subject, they described the complication of a superficial vascular membrane that developed over the cornea. It began at the limbus and later involved the entire structure, producing an unevenness of the corneal surface, lack of luster, and diminution of transparency.

C. Iris

The iris seems to be even less sensitive to irradiation than the cornea. Many investigators (Jacoby,[17] 1924; Rohrschneider,[20] 1929; Leinfelder and Kerr,[9] 1936; and others) gave heavy doses of roentgen rays with no apparent injury to the iris. Belley,[7] in 1907, noted retardation in pigment formation after the irradiation of young animals. Birch-Hirschfeld[12] (1904) drew attention to the hyperemia and slight thickening of the intima of some of the vessels in the iris following heavy irradiation of the rabbit's eye. Poppe[11] (1942) demonstrated thickening of the vessel walls in the iris following irradiation of the rabbit's eye, after double the dose had produced injury to the cornea. Desjardin[10] (1931) pointed out that reports of iritis and adhesions to the lens capsule occurred after a severe conjunctivitis and keratitis, and may be secondary to this process rather than the specific reaction to the rays. It seems certain that the blood vessels of the iris, as well as those in the conjunctiva and retina, are affected by suitable doses of radiation.

D. Lens

There are many more reports in the literature concerning injury to the lens than to any other part of the eye. In the radiosensitivity of the various structures of the eye, the lens has been placed in various positions

by different investigators. Many workers (Chalupecky,[15] 1897; Tribondeau and Laffargue,[22] 1907; Rados and Schinz,[16] 1922; Jacoby,[17] 1924; Desjardin,[10] 1931; Foy,[19] 1939; and others) considered the crystalline lens of adult animals to possess a high degree of resistance to irradiation.

Foy,[19] in 1939, listed the radiosensitivity of the various parts of the eye as follows: Palpebras, conjunctiva, cornea, lens, iris, choroid, retina, and optic nerve. Rohrschneider[20] (1929) considered the lens the most radiosensitive part of the eye, followed by the conjunctiva and cornea. He found no changes in the iris and retina attributable to roentgen rays.

The problem of postirradiation cataract has been of great importance in the treatment of lesions about the eye by this method. Birch-Hirschfeld[23] (1908) reported cataract two-and-one-half years following the treatment of a carcinoma of the eyelid. There have been numerous cases of cataract reported after therapeutic irradiation with roentgen rays or radium to the eye or its vicinity (Birch-Hirschfeld,[23] 1908; Paton,[24] 1909; Scheer,[25] 1925; Stock,[26] 1926; Moore,[27] 1931; Clapp,[28] 1932; Rohrschneider,[29] 1932; Reese,[30] 1939; Poppe,[31] 1939 and 1942;[11] Martin and Reese,[14] 1936, 1942,[21] and 1945;[32] Hunt,[13] 1947; and others).

Case reports have appeared in the literature of cataract (Moore,[27] 1931; Reese,[30] 1939) which occurred following roentgen irradiation. In these cases, no other sign of eye injury was noted and vision became normal after cataract extraction.

The exact method of production of the postirradiation cataract is still uncertain. Several investigators believe cataract formation is the result of direct injury to the lens epithelium (Rohrschneider,[29] 1929; Leinfelder and Kerr,[9] 1936; Poppe,[11] 1942). Others have theorized that lens injury is a nutritional phenomena secondary to the endarteric changes in the ciliary vessels (Aulamo,[33] 1928; Milner,[34] 1934).

Leinfelder and Kerr[9] (1936) carried out histologic studies on the rabbit's lens after roentgen radiation and found the earliest changes to occur in the equatorial region of the lens. These swollen pathologic fibers reached the posterior pole where the subcapsular opacities developed. After large roentgen doses, pathologic changes also developed in the anterior cortex.

Poppe[11] (1942) described cataract formation in the following manner, using hard (175 K.V.) X rays: There was a vacuolization of the cytoplasm of the lens epithelium immediately anterior to the equator 24 hours after the irradiation. There was also cessation of mitoses, which reappeared in an abnormal manner in six days. One month later, swollen lens fibers appeared in the equatorial regions. Similar changes gradually extended beneath the capsule from the equator, posteriorly and anteriorly, in a comparatively narrow zone. Four months later the cataract could be diagnosed clinically. Numerous opacities were seen peripheral to the posterior cortex, and fine vacuoles subcapsularly to the anterior cortex. The opacities grew denser for 12 months after the irradiation, and then remained unchanged. Poppe also found that, after single doses of such X rays up to 500 r, the lens epithelium regained its normal appearance. With doses above 500 r, the lens epithelium did not regain its normal appearance and all the fibers formed subsequently showed pathologic processes.

Another interesting phase of lens damage by X ray has been the long latent period between irradiation of the eye and the manifestation of the opacities. Clapp[28] (1932) collected from the literature 34 cases of cataract occurring after roentgen rays or radium therapy to various lesions about the eye and in X ray workers. Milner[34] (1934) observed 13 cases of cataract in patients treated for a variety of lesions about the eye. Three of these followed radium therapy. An analysis of these two papers shows the latent period to be from 9½ months to 12 years,

with an average of about two years.

Poppe[11] (1942) found the latent period for the clinical appearance of changes in the rabbit lens after roentgen rays to be from 4 to 9 months. He explained the long latent period to be due to the formation in the equatorial region of pathologic fibers from the injured epithelium. Clinical manifestations of cataract in Poppe's investigation roughly coincide with the appearance of pathologic fibers at the posterior pole.

Notwithstanding the many clinical and experimental papers, the exact dosages of X ray required to produce cataract in the human is still uncertain.

E. Retina and Optic nerve

The early experiments on the irradiation of eyes in newborn and young animals (Tribondeau and Recamier,[6] 1905; Belley,[7] 1907; and others) all showed retardation in development of the retina and of the eyeball as a whole. In the exposure of the fully developed eye of the adult animal, the retina and optic nerve appear to possess a high degree of radio resistance. In the biologic effect of irradiation in general, nerve tissue is regarded as one of the most radio resistant. However, sufficiently high doses of radiation can cause degenerative changes, as first demonstrated by Birch-Hirschfeld.

Recently, Martin and Reese[14] (1936) (1945)[22] treated retinal gliomas with high doses of roentgen rays. This was directed to the posterior segment of the eye, given in fractionated doses over a period of many months. They observed profound changes in the retina. Marked edema of the retina appeared during the course of treatment and afterward subsided. Six to 18 months later, Martin and Reese also found new vessels growing into the site of the irradiated lesion, probably due to telangiectatic phenomena such as occurs following irradiation to the skin. Other reports are available in the literature but need not be reviewed for the purpose of this paper, because we are dealing with extremely low dosages of a soft X ray which offers practically no possibility of retinal damage. Clinically, 400 r or less are given at monthly intervals, only 20 percent of which reach the anterior vitreous and a negligible amount more posteriorly.

IV. Purposes of experiments

Experiments were undertaken with rabbits to determine the following:

1. The effect of varying amounts of low-voltage X rays delivered from the Philips tube upon the normal rabbit eye.
2. The effectiveness of various dosages of low-voltage X rays in the prevention or elimination of experimentally induced corneal vascularization in the rabbit.
3. The histologic changes which occurred as a result of low-voltage irradiation.

V. Apparatus and technique

The Philips contact-therapy machine was used in all experiments. No additional filter was employed. Exposure was given with the tube in contact with the cornea. Adult rabbits were used in all experiments. The right eye was treated and the left kept as a control. The treated eye was proptosed to facilitate application of the tube in all experiments except the first, where the effect of irradiation to adjacent portions of the eyelids was also observed. The rabbits were held in a rabbit box. Pontocaine hydrochloride was instilled for local anesthesia. Observations were made twice weekly with the loupe and slitlamp. All eyes were stained with fluorescein. Photographs were taken at regular intervals. Animals were killed periodically to permit removal of their eyes for histologic study.

VI. Experimental data

A. The effect of low-voltage roentgen rays upon the normal eye of the rabbit

1. Exposure to Anterior Segment of Eyeball and Eyelids

Preliminary survey experiments were done in an attempt to find the approximate

limits of tolerance of the rabbit eye to low-voltage X ray. Only six rabbits were used; one for each dosage level of 400 r, 600 r, 800 r, 2,000 r, 6,000 r, and 10,000 r. These dosages were given weekly for five weeks. A 15-mm. cone aperture was used. The lids were retracted with a small lid speculum. When the tube was brought in contact with the center of the cornea, the entire cornea, the surrounding bulbar conjunctiva, and adjacent portions of the lids were exposed to irradiation. The following changes were searched for: (a) Epilation, (b) edema of lids, (c) conjunctival injection, (d) conjunctival discharge, (e) staining of cornea, (f) corneal infiltration and neovascularization, (g) lens changes, and (h) fundus changes.

The animals were followed for four and one-half months.

Results (table 1)

a. Epilation. Epilation involving the eyelids occurred in rabbits receiving 2,000 r or more. It appeared four weeks after the first treatment in the animal receiving 2,000 r but in only two weeks in the rabbit receiving 10,000 r. Epilation was permanent throughout the period of observation of approximately four-and-one-half months.

b. Edema of lids. Edema of the lids was seen only in rabbits receiving doses of 6,000 r or more. It occurred during the fourth week and persisted for 2 or 3 weeks in the two rabbits which received 6,000 r and 10,000 r.

c. Conjunctival injection. Conjunctival injection was present during the fourth and fifth weeks in animals receiving 400 r, 600 r, and 800 r; during the second through the eighth week in those receiving 2,000 r and 6,000 r; and from the first through the 11th week in the animal receiving 10,000 r.

d. Conjunctival discharge. Conjunctival discharge was negligible from eyes receiving less than 2,000 r. A mucopurulent discharge occurred in the eyes which received 2,000 r, 6,000 r, and 10,000 r as early as the second week and persisted through the 11th week. It appeared a few days later and disappeared approximately three weeks earlier in the animal which had the smaller dosage of 2,000 r.

e. Staining of cornea. Punctate corneal staining with fluorescein was found in the animals which received 6,000 r and 10,000 r at each exposure. The staining began during the fourth week of treatment and persisted through the sixth week in the animal receiving 6,000 r and through the eighth week in

TABLE 1

EFFECT OF VARIOUS DOSAGES OF LOW-VOLTAGE ROENTGEN RAYS UPON THE NORMAL RABBIT EYE*

Dosage	Lid Changes	Conjunctival Changes		Corneal Changes		Cataracts	Fundus Changes
		Injection	Discharge	Corneal Staining	Corneal Infiltrate		
400 r	0	Transient 4th week	Transient 4th week	0	0	0	0
600 r	0	4th and 5th week	0	0	0	0	0
800 r	0	4th and 5th weeks	0	0	0	0	0
2,000 r	Epilation permanent, 4th week.	2nd through 8th week	3rd through 8th week	0	Nebular 4th and 5th week.	0	0
6,000 r	Epilation permanent, 4th week. Lid edema 4th through 6th week.	2nd through 8th week	2nd through 8th week	4th through 6th week	Nebular 3rd through 8th week.	0	0
10,000 r	Epilation permanent, onset 2nd week. Lid edema 4th through 7th week.	1st through 11th week	2nd through 11th week	4th through 8th week	Nebular 4th week. Leukoma developed. Lesion vascularized 8th week.	Lens not seen.	Fundus not seen.

* Exposure through 15-mm. portal which included anterior segment of eye and adjacent eyelids, given weekly for five weeks to one rabbit at each dosage level.

the one receiving 10,000 r. This was probably associated with epithelial edema.

f. Corneal infiltrate. Corneal infiltrate occurred in the animals receiving 2,000 r or more. It began as a nebular opacity associated with corneal edema during the fourth week of exposure in the animals receiving 2,000 r and 10,000 r and during the third week in the animal receiving 6,000 r. The opacity disappeared in about a week from that which received 2,000 r. It persisted for five weeks in the animal receiving 6,000 r at each dosage, while in the animal receiving 10,000 r it went on to the formation of a leukomatous scar. Neovascularization which greatly resembled pannus formation also occurred in this cornea.

g. Lens changes. Cataracts were not found by slitlamp examination. The lens, however, could not be seen in the animal receiving 10,000 r because of the corneal scar.

h. Fundus changes. No fundus changes were observed.

Summary

1. Epilation of the eyelids of rabbits was produced by dosages of 2,000 r or more.

2. Conjunctival injection and discharge were temporary when they occurred.

3. Punctate corneal staining occurred in animals receiving dosages of 6,000 r or more.

4. Corneal infiltrate, transient in nature, appeared in the animals receiving 2,000 r and 6,000 r.

5. A permanently opaque highly vascularized cornea was produced in the animal which received 10,000 r.

Conclusion

Dosages of 2,000 r or more given weekly for five weeks to the anterior segment of the eye endanger the cornea.

TABLE 2

EFFECT OF VARIOUS DOSAGES OF LOW-VOLTAGE ROENTGEN RAYS UPON THE NORMAL RABBIT EYE*

Dosage	Punctate Staining of Cornea	Corneal Infiltrate	Corneal Ulceration	Corneal Vascularization	Lens Changes
500 r	Transient 1st and 2nd weeks	Transient 20th to 28th week, 1 rabbit.	0	0	None clinically
1,000 r	Transient 2nd and 3rd weeks	Transient 9th to 11th week, 1 rabbit.	0	0	None clinically
3,000 r	Transient First 4 weeks	Transient 5th to 20th week, all rabbits.	0	0	None clinically
5,000 r	Transient First 5 weeks	Onset 6th week to 20th week, all rabbits. Permanent opacity, 1 rabbit.	13–20th week, 1 rabbit. Descematocele.	Onset 20 weeks, 1 rabbit.	Posterior subcapsular opacities, 1 rabbit.
10,000 r	Constant, progressed to ulceration.	Onset 6 weeks. Permanent opacity, all rabbits.	Onset 15th week, 1 rabbit. Staphylomatous.	Onset 11 weeks, all rabbits.	Lens not seen, corneal opacity.

* Exposure limited to a five-mm. portal at center of cornea, given once weekly for 21 weeks to three rabbits each dosage level.

2. Exposure Limited to Center of Cornea (five-mm. cone aperture)

In the previous experiment, the conjunctiva was relatively resistant to low-voltage irradiation, showing only hyperemia even with dosages of 10,000 r for five consecutive weeks. The cornea, however, seemed more sensitive, developing transient corneal haze at dosage levels of 2,000 r to 6,000 r given over the same length of time and permanent opacity with exposures of 10,000 r. It, therefore, seemed of value to determine the effect of irradiation limited to the cornea only, the limbal circulation not being irradiated.

The cornea was exposed through a cone with a five-mm. opening which limited exposure to less than the corneal diameter.

Adult gray mongrel rabbits were used. Five groups of three rabbits each were given dosages of 500 r, 1,000 r, 3,000 r, 5,000 r, and 10,000 r respectively at weekly intervals for 21 weeks, the longest observations being made 14 months after the first treatment was administered. An occasional animal was killed in each group to permit histologic study of the eyes.

Results (table 2)

a. Corneal staining. Punctate staining of the cornea appeared in the treated eyes receiving 500 r, 1,000 r, 3,000 r, and 5,000 r. This was first seen in all groups during the first or second weeks and lasted as long as five weeks in the animals which received 5,000 r. In the others it cleared somewhat earlier. In the animal which received 10,000 r, the punctate staining areas coalesced until frank corneal ulceration had developed.

b. Corneal infiltrate. Corneal infiltrate of nebular density, probably chiefly edema, appeared in the 20th week in one eye receiving 5000 r, clearing eight weeks later. It was found likewise in one eye of the 1,000-r group, appearing in the ninth week and lasting two weeks. Similar changes occurred in all eyes receiving 3,000 r, the opacity lasting from the fifth to the 20th week. All rabbits in the group receiving 5,000 r developed a more dense corneal infiltrate with onset during the sixth week, lasting through the 20th week. It remained as a permanent, dense opacity in all of these animals. All of the eyes receiving 10,000 r developed a corneal opacity which was at first nebular and later progressed to result in a permanently opaque cornea (fig. 5).

c. Corneal ulceration. Corneal ulceration occurred in only two eyes, one receiving 6,000 r and the other 10,000 r. In the eye receiving 6,000 r, it developed during the 13th week and eroded the cornea to the point of descematocele formation. The cornea of the rabbit receiving 10,000 r became staphylomatous (fig. 6).

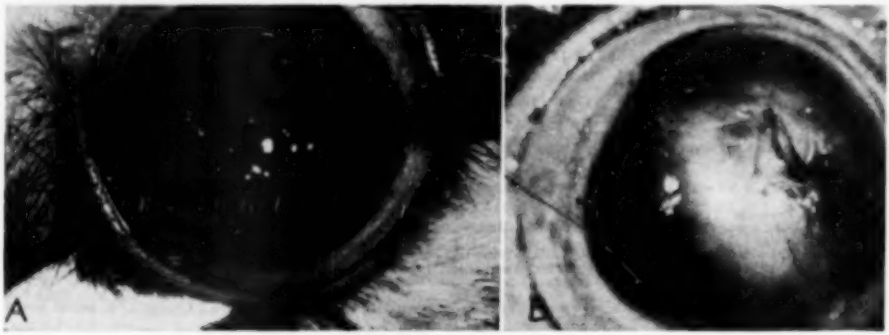

Fig. 5 (Scheie, *et al.*). Corneal opacity resulting from 10,000 r weekly for 21 weeks. (A) Opacity of macular density five months after first exposure. (B) Corneal leukoma 13 months after first exposure.

d. Corneal vascularization. Neovascularization of the cornea resembling pannus developed in some of the eyes receiving 3,000 r or more. It occurred in only one of the three eyes receiving 3,000 r, starting during the eighth week of exposure. Likewise, one of the eyes in the group receiving 5,000 r developed similar vascularization but its onset was later, during the 20th week. All of the eyes receiving 10,000 r developed neovascularization beginning at approximately the 11th week. These newly formed vessels persisted until the animals were killed for pathologic studies. One of the animals was

permitted to live for 14 months following the first treatment and at that time still had pannus formation with many epithelial blebs on his opaque cornea.

e. Lens changes. Lens changes were encountered in only one rabbit in this entire series of experiments. They were found at slitlamp examination in one rabbit of the 5,000-r group, 14 months after the first exposure. Numerous posterior subcapsular vacuolar opacities were noted. The lens of the group receiving 10,000 r could not be examined because of the corneal opacity.

Pathology

Microscopic studies were made of eyes from each group except those receiving 5,000 r. No pathologic changes occurred in eyes receiving less than 3,000 r. Some of the eyes were followed as long as 14 months after exposure to X ray.

Two of the three rabbit eyes receiving 3,000 r showed no pathologic change. The other showed epithelial edema with some loss of cells centrally. The corneal stroma was also edematous and the anterior third vascularized. No cataractous changes characteristic of those due to X ray were present.

One eye that received 10,000 r was subjected to microscopic study 14 months after X-ray therapy. The cornea was thinned. A dense scar involving all layers of the cornea was present. The stroma was vascularized through all layers. The epithelium showed distorted nuclei and was keratinized. The lens showed progression of the epithelial cells around the equator. These cells were distorted and swollen. The recently formed lens fibers showed albuminous degeneration. These could be considered characteristic of irradiation cataract.

Summary

1. Dosages of 500 r and 1,000 r given weekly for 21 weeks with exposure limited to the cornea produced no permanent ill effects upon the normal eye of the rabbit.

2. Dosages of 3,000 r or more resulted in newly formed vessels in the cornea. In the larger dosages, corneal ulceration and permanent opacity can also occur.

3. Cataractous change was seen in one animal receiving 5,000 r when examined 14 months after the first exposure.

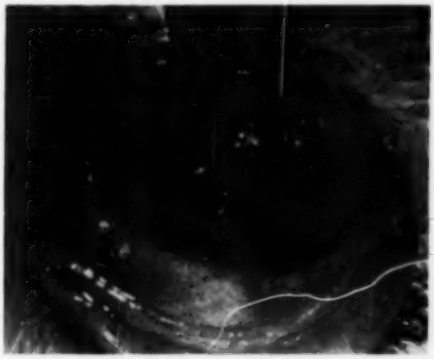

Fig. 6 (Scheie, *et al.*). Staphyloma of cornea 16 weeks after first exposure. Dosage of 10,000 r weekly for 16 weeks.

Conclusion

Dosages up to 1,000 r given weekly for 21 weeks to the cornea caused no apparent damage to normal rabbit eyes.

B. THE EFFECT OF LOW-VOLTAGE ROENTGEN RAYS IN THE PREVENTION OF EXPERIMENTALLY PRODUCED CORNEAL VASCULARIZATION IN THE RABBIT

The remainder of the experimental work in this paper was undertaken to determine the effect of low-voltage irradiation on experimentally induced corneal vascularization, the X ray being given in amounts that had caused no damage to the normal rabbit eye. In the first group of experiments, dosages at various levels were used, including 2,000 r given weekly for as long as eight weeks. This was felt to be a relatively safe exposure, because no cataracts had resulted from such exposures in the preliminary experiments just discussed and no permanent corneal changes resulted unless the ex-

posures were 3,000 r or more. Any future clinical work with such irradiation would probably have to be within such dosage levels.

Corneal vascularization was produced by injecting sodium hydroxide into the cornea as suggested by the method of Iliff.[35] Adult albino rabbits were used for the experiments. Both eyes of each rabbit were injected intracorneally with 0.04 cc. of 0.15 normal sodium hydroxide. A white area approximately five mm. in diameter resulted immediately. The injection was made eccentrically between the upper limbus and the center of the cornea in such a way that the NaOH lesion involved only the upper half of the cornea. The uniformity of the lesion was remarkable in all eyes and followed a consistent course in all untreated eyes. A dense opacity about five mm. in diameter occurred at the site of the injection. Vascularization always proceeded from the upper limbal region, commencing 2 to 4 days after the injection. It proceeded in the untreated eyes until it reached a maximum in 3 to 4 weeks, at which time the peripheral two thirds to three fourths of the opacity had become vascularized.

The right eye was exposed to X ray in all of the experiments, while the left eye was left untreated as a control. Three groups of experiments were carried out, differing mainly as to the time at which irradiation was started in relation to the sodium-hydroxide injection, or as to the interval of time between exposures.

TABLE 3

INHIBITING EFFECT OF LOW-VOLTAGE ROENTGEN RAYS GIVEN WEEKLY FOR EIGHT WEEKS ON NaOH-INDUCED CORNEAL VASCULARIZATION*

Dosage	Infiltrate	Maximum Extent of Vascularization (5 weeks)		Maximum Density of Vascularization		Size of Vessels at Height of Reaction		Result
	NaOH 0.15 N 0.04 cc. Intracorneally	Exposed	Unexposed	Exposed	Unexposed	Exposed	Unexposed	
500 r	Uniform opaque 5 mm. infiltrate, all animals.	3–4 mm. Rate of growth inhibited.	4–5 mm.	3 plus	2 plus	Attenuated.	Size of limbal vessels.	Results inconclusive. Rate of invasion of cornea by vessels inhibited by all dosages.
750 r	Uniform opaque 5 mm. infiltrate, all animals.	3–4 mm. Rate of growth inhibited.	4–5 mm.	3 plus	2 plus	Attenuated.	Size of limbal vessels	Extent of growth slightly limited by smaller dosages.
1,000 r	Uniform opaque 5 mm. infiltrate, all animals.	4–5 mm. Rate of growth inhibited.	4–5 mm.	3 plus	2 plus	Attenuated.	Size of limbal vessels.	
1,500 r	Uniform opaque 5 mm. infiltrate, all animals.	4–5 mm. Rate of growth inhibited.	4–5 mm.	3 plus	2 plus	Attenuated.	Size of limbal vessels.	
2,000 r	Uniform opaque 5 mm. infiltrate, all animals.	4–5 mm. Rate of growth inhibited.	4–5 mm.	3 plus	2 plus	Attenuated.	Size of limbal vessels.	

* Exposure started on day of intracorneal NaOH injection, prior to onset of vascularization.

1. Exposure Given Immediately Following Intracorneal Sodium-Hydroxide Injection

Both corneas were injected with NaOH and the right treated with X ray. Dosages of 500 r, 750 r, 1,000 r, 1,500 r, and 2,000 r were given weekly for eight weeks. Exposure was given through a 10-mm. aperture placed astride the limbus directly over the lesion with the eyeball proptosed to avoid eyelid reaction. Pontocaine anesthesia was given. Five groups of three rabbits each were used for the experiment. The eyes were examined twice weekly particularly for any effect the irradiation might have on the proliferation of vessels into the NaOH lesion, the density of the neovascularization, and the size of the newly formed vessels in both the treated and untreated eyes.

Results (table 3)

a. Effect upon NaOH lesion. The opacity produced by the sodium-hydroxide injection was unaffected in its early stages by exposure with the Philips apparatus in the dosages and for the time intervals employed in this experiment. The punctate staining, previously observed in control experiments, occurred but produced no ill effect.

b. Extent of vessels into the cornea. The smaller dosages of 500 r and 750 r seemed to diminish somewhat the extent of the newly formed vessels into the lesion, an average difference of 1.0 mm. between the irradiated and control eye being recorded. However, in dosages of 1,000 r, 1,500 r, and 2,000 r, no difference was seen. The rate of growth of vessels was also inhibited by the X ray in all groups. The maximum extent of vascularization occurred a few days earlier in the untreated than in the treated eyes.

c. Density of vascularization. The vessels growing into the lesion in the treated eyes were more dense and matlike than those in the control eyes, although the difference was not as marked as in some later experiments.

d. Size of vessels. The vessels in the treated eyes were definitely more attenuated than those of the untreated eyes where the vessels growing onto the cornea seemed to be approximately the size of the vessels from which they arose at the limbus.

Pathology

Eyes were examined from all dosage levels except 1,500 r. The appearance of the lesion caused by the intracorneal NaOH injection varied depending upon the time at which the animal was killed. Early in its course the lesion was characterized by edema at the site of injection. Cellular infiltrate was never marked unless corneal ulceration had occurred. Hyperplasia of the corneal endothelium was found in all eyes beneath the NaOH lesion. The endothelium was frequently 10 or 12 layers thick. Later the edema gradually cleared and the cellular infiltrate absorbed. The endothelium remained thickened. Vascularization, usually involving the anterior third of the stroma, was uniform in all eyes unexposed to X ray. The lesions in eyes receiving the smaller dosages of 500 r and 750 r were less extensively vascularized than in the untreated eyes. No harmful changes were seen which could be attributed to X ray.

Summary

1. The rate of growth of vessels into the cornea was slightly inhibited by all dosages.

2. The extent of the newly formed vessels into the cornea was somewhat limited by the smaller doses of 500 r and 750 r. Larger doses had no such effect.

3. The vessels were slightly more dense in the treated eye.

4. The vessels were slightly attenuated in the treated eye.

Conclusion

Small dosages (500 r and 750 r to 1,000 r) from the Philips tube given weekly for eight weeks, started at the time of the intracorneal NaOH injection, inhibited the rate and extent of growth of new vessels into NaOH-produced corneal lesions.

2. Exposure Given after Onset of Corneal Vascularization (four Days after Intracorneal NaOH Injection)

The following experiment was carried out to determine the effect of small dosages of low-voltage X ray in retarding vascularization when given after the vessels had begun to invade the cornea, in contrast to the previous experiment where the eyes had been irradiated at the time of the NaOH injection.

Because smaller doses had been more effective in the previous experiment, dosages of 300 r to 1,000 r were used in this experiment.

The first dosage was given to all animals four days following the intracorneal injection of sodium hydroxide, by which time

numerous vessels had begun to invade the cornea from the limbus adjacent to the infiltrate caused by the sodium hydroxide. Exposures were given through two five-mm. portals to adjacent areas over the limbus nearest the lesion. Our aim was to limit exposure to the region of the limbus from which the vessels arose.

A. Eyes irradiated once weekly

Five groups of five rabbits each were given weekly exposures of 300 r, 400 r, 550 r, 750 r, and 1,000 r. Animals were killed at varying intervals following the first treatment for microscopic study of the excised eyes. One animal from each group was killed at the end of the 2nd, 3rd, 4th, and 5th weeks of treatment. The fifth animal in each group was permitted to live for eight months unless he died of natural causes in the meantime.

Results (table 4)

a. Effect upon NaOH lesion. The immediate appearance of the infiltrate caused by sodium hydroxide remained unchanged following irradiation of the eye. (Eight months later, however, when the last animal was killed, the eventual scar was less dense in the treated than in the untreated eyes.)

b. Extent of vessels into the cornea. The proliferation of blood vessels into the lesion was markedly inhibited by X rays. (fig. 7). This effect was more marked in the animals receiving the larger dosages of 750 r and 1,000 r. The difference between the treated and untreated eyes became apparent early in the second week following the first irradiation. Subsequent to this time, the vessels in the treated eye, particularly those receiving the larger dosages, showed much less tendency to extend into the corneal lesion than they did in the untreated eye. The difference in appearance between the two eyes was rather striking. The vessels in the treated eyes ended abruptly at a uniform distance 2 to 3 mm. from the limbus. The limiting border was rather sharp; whereas, the vessels in the untreated eye extended onward 4 to 5 mm. into the cornea in a rather irregular manner, some of the vessels being considerably in advance of others.

c. Density of vascularization. In addition to being sharply delimited, the number of vessels running from the limbus in the treated animals was greatly in excess of those in the untreated eye.

TABLE 4

INHIBITING EFFECT OF LOW-VOLTAGE ROENTGEN RAYS GIVEN WEEKLY FOR FIVE WEEKS TO NaOH-INDUCED CORNEAL VASCULARIZATION*

Dosage	Infiltrate	Maximum Extent of Vascularization (3 weeks)		Maximum Density of Vascularization		Size of Vessels at Height of Reaction		Result
	NaOH 0.15 N 0.04 cc. Intracorneally	Treated	Untreated	Treated	Untreated	Treated	Untreated	
300 r	Uniform opaque 5 mm. infiltrate, all animals.	3.5 mm.	4–5 mm.	3 plus	2 plus	Slightly attenuated.	Size of limbal vessels.	Vascularization slightly inhibited. Resultant corneal scar less marked.
400 r	Uniform opaque 5 mm. infiltrate, all animals.	3.5 mm.	4–5 mm.	3 plus	2 plus	Slightly attenuated.	Size of limbal vessels.	Vascularization slightly inhibited. Resultant corneal scar less marked.
550 r	Uniform opaque 5 mm. infiltrate, all animals.	3.0 mm.	4–5 mm.	3 plus	2 plus	Slightly attenuated	Size of limbal vessels.	Vascularization moderately inhibited. Resultant corneal scar less marked.
750 r	Uniform opaque 5 mm. infiltrate, all animals.	2–3 mm.	4–5 mm.	3 plus	2 plus	Attenuated.	Size of limbal vessels.	Vascularization markedly inhibited. Resultant corneal scar less marked.
1,000 r	Uniform opaque 5 mm. infiltrate, all animals.	2.0 mm.	4–5 mm.	3	2	Attenuated.	Size of limbal vessels.	Vascularization markedly inhibited. Resultant corneal scar less marked.

* Exposure started after corneal vascularization had begun.

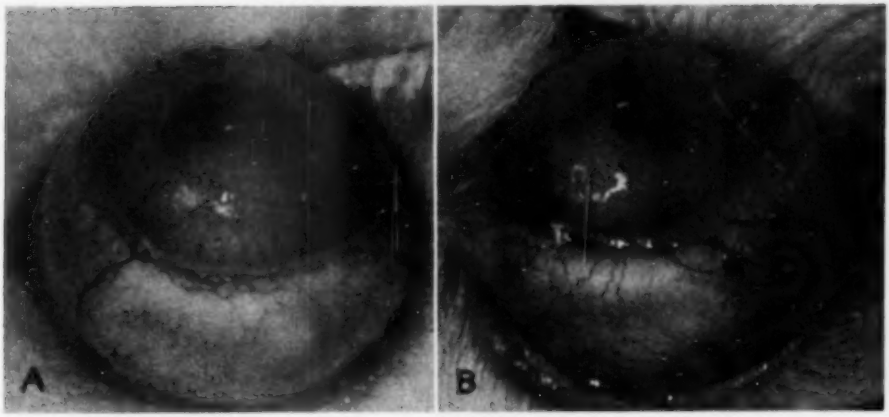

Fig. 7 (Scheie, *et al.*). Inhibition of vascularization of NaOH lesion by low-voltage X ray. Dosage of 1,000 r weekly. First exposure after onset of vascularization. Photograph taken three weeks after first exposure. (A) Untreated left eye, showing vascularization of entire lesion. (B) Treated right eye, showing vascularization limited to limbus.

d. Size of newly formed vessels. The vessels in the treated eyes were very fine. The vessels in the untreated eyes, although less numerous than those in the treated eye, were considerably larger, appearing almost as direct extensions of the normal vessels at the limbus. After the first 4 or 5 weeks, the vessels remained stationary.

e. End result. When the eyes were examined eight months later, residual vessels could be seen at precisely the areas where they had been found during the 4th and 5th weeks. The eye in the meantime had lost its angry inflamed appearance. At that time, however, the scar was less dense in the treated than the untreated eyes. This might suggest that, rather than being beneficial, newly formed blood vessels promote scarring of the cornea following this type of lesion. The presence of residual vessels in the treated eye seemed to signify that, although this type of irradiation could check the growth of vessels into the cornea, it was unable to eliminate vessels already present or at any rate all of such vessels. The vascularized appearance of both the treated eyes and the untreated eyes quite naturally appeared less marked at the end of eight months when the eyes had become quiet.

Pathology

Eyes from all dosage levels were studied, some having been followed for as long as 14 months. The only effects which could be attributed to X ray were those found in vascularization of the NaOH lesion. Invasion of the lesion by vessels showed some limitation in the treated eyes. The lesion was entirely vascularized in most of the untreated eyes but the treated ones showed vascularization of only the peripheral one half to three quarters of the area. The vessels in all eyes showed a tendency to regress as the lesion became older. The scar appeared equally dense microscopically in the treated and untreated eyes. No damage, such as irradiation cataract, had been caused by the X ray.

Conclusions

1. Low-voltage roentgen rays given following the onset of vascularization caused by sodium hydroxide limit the extent of corneal vascularization.

2. The resultant scar is less dense and opaque in the treated eye than in the untreated eye when observed eight months later.

B. Eyes irradiated daily

The final experiment was carried out in a manner identical to Experiment 4, except that irradiation was given daily, hoping to determine whether or not exposures given in this manner might be more effective in inhibiting vascularization than when given weekly.

Five groups of five rabbits each were given dosages of 300 r, 400 r, 550 r, 750 r, and 1,000 r, respectively, daily for 16 days. Two five-mm. portals were again used. The first treatment was again given four days after the intracorneal injection of sodium hydroxide, the time at which vascularization had already begun in each eye. One animal from each group was killed for microscopic study of the excised eyes on the day after the 2nd, 7th, and 14th treatment and one week after the 16th treatment. The final rabbit in the group was killed eight months later.

Results (table 5)

a. Effect upon NaOH lesion. No immediate effect upon the NaOH infiltrate was seen as a result of irradiation.

b. Extent of vascularization. The differences in vascularization of the NaOH lesion were much more striking following daily exposure than in the previous experiment in which exposure had been given weekly. In the previous experiment there seemed to be little inhibition of vascularization until the second week following the first exposure. When exposed daily, however, a definite difference could be seen by the end of the first week. Following this time, invasion of the sodium-hydroxide lesion by vessels was entirely prevented in the treated eyes; whereas, it continued in the usual manner in the control eyes. The vessels were inhibited equally by all of the dosages used, from 300 r to 1,000 r (figs. 8, 9, 10, and 11). As in the previous experiment, the vessels ended abruptly a uniform distance from the limbus in the treated eyes but they rarely extended more than 1.5 to 2.0 mm. into the cornea.

c. Density of vascularization. The number of vessels was greater in the eye which received X ray, usually being dense and epaulettelike.

e. Size of newly formed vessels. The vessels were again very attenuated in the treated eye in contrast to the untreated, where

TABLE 5

INHIBITING EFFECT OF LOW-VOLTAGE ROENTGEN RAYS GIVEN DAILY FOR 16 DAYS ON NaOH-INDUCED CORNEAL VASCULARIZATION*

Dosage	Infiltrate	Maximum Extent of Vascularization (3 weeks)		Maximum Density of Vascularization		Size of Vessels at Height of Reaction		Result
	NaOH 0.15 N 0.04 cc. Intracorneally	Treated	Untreated	Treated	Untreated	Treated	Untreated	
300 r	Uniform opaque 5 mm. infiltrate, all animals.	1.5 mm.	4–5 mm.	4 plus	2 plus	Attenuated.	Size of limbal vessels.	Vascularization markedly inhibited by all doses.
400 r	Uniform opaque 5 mm. infiltrate, all animals.	1.5 mm.	4–5 mm.	4 plus	2 plus	Attenuated.	Size of limbal vessels.	
550 r	Transient corneal haze in addition to NaOH lesion, 2 of 5 treated rabbits, 10 days.	1.5 mm.	4–5 mm.	4 plus	2 plus	Attenuated.	Size of limbal vessels.	Resultant corneal opacity considerably less dense in treated eyes.
750 r	Transient corneal haze in addition to NaOH lesion, all treated rabbits, 8 days.	1.5 mm.	4–5 mm.	4 plus	2 plus	Attenuated.	Size of limbal vessels.	
1,000 r	Transient corneal haze in addition to NaOH lesion, all treated rabbits, 8 days.	1.5 mm.	4–5 mm.	4 plus	2 plus	Attenuated.	Size of limbal vessels.	

* Exposure started after corneal vascularization had begun.

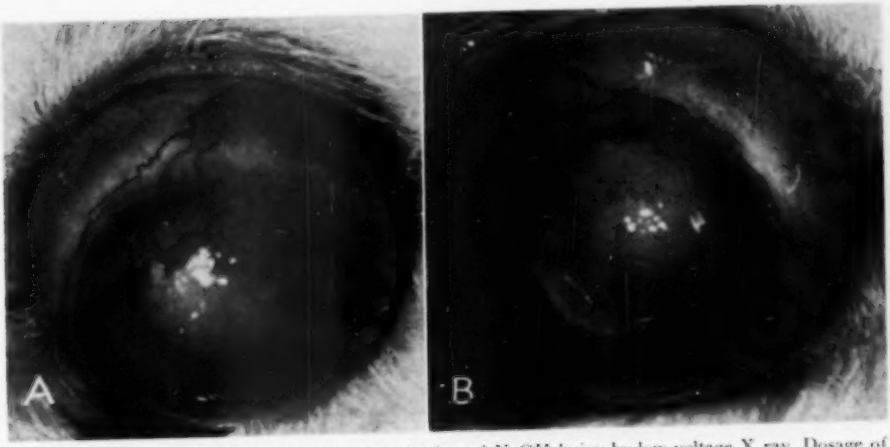

Fig. 8 (Scheie, *et al.*). Inhibition of vascularization of NaOH lesion by low-voltage X ray. Dosage of 300 r daily. First exposure after onset of vascularization. Photograph taken after 10th exposure. (A) Untreated left eye, showing vascularization of entire lesion. (B) Treated right eye, showing vascularization limited to limbus.

they seemed to be direct extensions of the limbal vessels.

f. End result. After the first month or two, regression occurred. Residual vessels could be seen extending to or beyond the center of the sodium-hydroxide lesion in the untreated eyes and likewise ghost vessels could be seen in the treated corneas only at their original site at the periphery, showing that no further vascularization had occurred. The resultant scar was also less marked in the treated eyes which again suggested that the vascularization certainly had no beneficial effect upon sodium-hydroxide induced corneal lesions in the rabbit.

Pathology

Eyes from all dosage levels were studied, some again having been followed for as long as 14 months after X-ray therapy. As in the

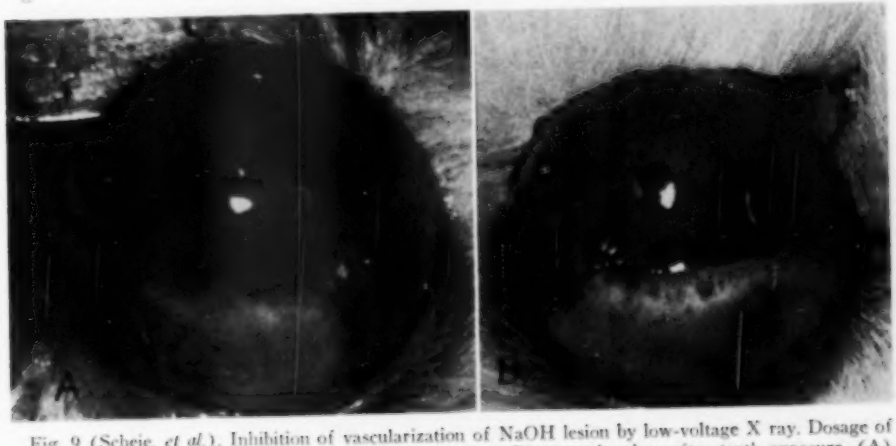

Fig. 9 (Scheie, *et al.*). Inhibition of vascularization of NaOH lesion by low-voltage X ray. Dosage of 400 r daily. First exposure after onset of vascularization. Photograph taken after tenth exposure. (A) Untreated left eye, showing vascularization of outer two thirds of lesion. (B) Treated right eye, showing vascularization limited to periphery of lesion.

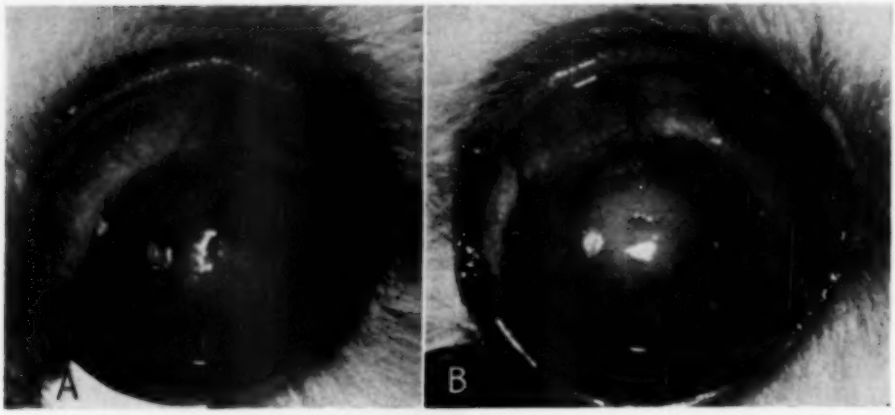

Fig. 10 (Scheie, *et al.*). Inhibition of vascularization of NaOH lesion by low-voltage X ray. Dosage of 550 r daily. First exposure after onset of vascularization. Photograph taken after tenth exposure. (A) Untreated left eye, showing vascularization of outer half of lesion. (B) Treated right eye, showing vascularization limited to periphery of lesion.

previous series of animals, the extent of the vascularization of the NaOH lesion was less in the treated eyes, but the difference was more marked in the present series. No cataract or other evidence of damage due to X ray was found.

Conclusions

1. Daily exposures with low-voltage roentgen rays given after the onset of vascularization exert an earlier and more profound inhibitory effect upon sodium-hydroxide induced corneal vascularization with smaller dosages than when given weekly.

2. The resultant scar is less marked in treated eyes than in the untreated eyes.

VII. Summary

The experimental work in this paper presented studies of the effect of low-voltage

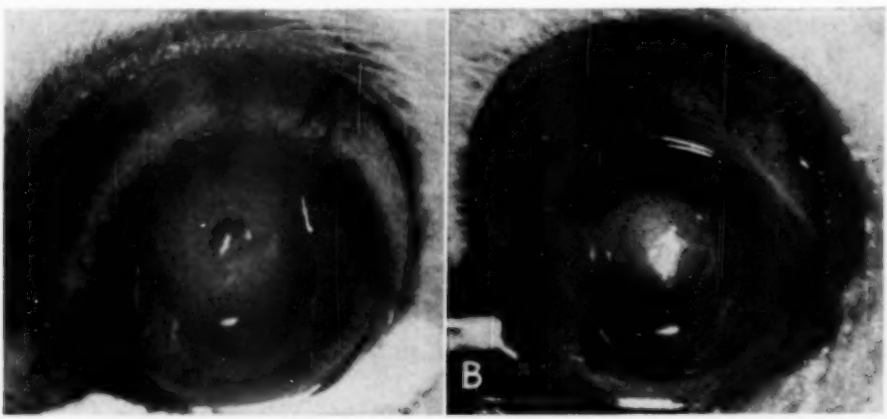

Fig. 11 (Scheie, *et al.*). Inhibition of vascularization of NaOH lesion by low-voltage X ray. Dosage of 1,000 r daily. Animal had 16 daily exposures. Photograph taken three-and-one-half weeks after first exposure. (A) Untreated left eye, showing vascularization of outer three fourths of lesion. (B) Treated right eye, showing vascularization limited to periphery of lesion.

roentgen irradiation from the Philips apparatus (44 K.V.) upon the normal rabbit eye, as well as observations upon the inhibitory effect of such rays upon experimentally induced corneal vascularization.

The need for such controlled experiments is obvious. Little experimental evidence has accumulated to support various claims as to the clinical effect of low-voltage X rays upon the eye. Although information is available for such beta irradiation, it cannot be accurately interpreted and applied to problems involving X-ray therapy of the eye. Furthermore, since beta irradiation with radon as a source can be used only where a radon emanation plant is available as a source of supply, it would be advantageous to use X ray which is more widely available.

Radium-D applicators are expensive and their use is practically limited to the eye. Low-voltage X-ray therapy machines, on the other hand, possess the advantage of wide usefulness in other fields of therapy.

X-ray therapy has been used about the eye with hesitation since the time of Birch-Hirschfeld, 1908, who first reported cataracts following X-ray therapy. His cases, however, as well as all of those reported since, followed X-ray therapy to the eye or the neighborhood of the eye with a machine operated on a very high kilovoltage which gives hard rays of great penetrating qualities.

In recent years, the Philips and Bracke-Seib machines, which give off X rays of low kilovoltage that are very soft and penetrate tissues poorly, have become available. The factor of safety of such machines is relatively great. If a 100-r dosage is given to the surface of the eye with the 100-K.V. machine, 80 percent reaches the lens; with the Philips machine (44 K.V.) only 36 percent reaches the lens. Although this penetration is greater than beta irradiation, the Bracke-Seib apparatus (10 K.V.) emits still softer rays of which only 10 percent penetrate to the lens compared to 18 percent for beta irradiation. Almost no possibility of injury to the lens exists, therefore, with such a machine. Work is now in progress to determine its therapeutic effectiveness. The recent experimental work was done with a Philips (44 K.V.) machine, because at the time the work was started, two years ago, it was the only low-voltage machine available.

The first two series of animal experiments, devoted to work with the normal eye of the rabbit, were undertaken to find the approximate limits of tolerance of the anterior segment of the eye, particularly the cornea and the lens. These experiments demonstrated that, if the irradiated area included the cornea, adjacent conjunctiva, and sclera, dosages up to 2,000 r could be given weekly for as long as five weeks with no apparent ill-effect occurring in the cornea or lens. When exposure was limited to the center of the cornea through a five-mm. portal, dosages up to 5,000 r weekly for as long as 21 weeks caused no permanent damage.

Production of cataracts was observed only twice. This occurred in animals which received 5,000 r and 10,000 r respectively weekly for 21 weeks. Animals receiving smaller dosages showed no lens changes. The longest period of observation, however, was 14 months. This was a considerably larger dosage than Poppe had found, but his work had been done with a high K.V. machine.

The second phase of the experimental work reported in this paper presents observations of the effect of low-voltage X rays upon experimentally induced corneal vascularization. Both eyes of rabbits were injected with sodium hydroxide which produced a dense corneal infiltrate about five-mm. in diameter. Within four days a rather heavy ingrowth of newly formed blood vessels began to invade the periphery of the cornea nearest the lesion and shortly vascularized the lesion itself. In the first experiment, the right eye was irradiated with varying dosages of X rays at the time of the sodium-hydroxide injection, the left eye being kept

as a control. The results obtained were rather indecisive, although the smaller doses of 750 r and 1,000 r slightly inhibited the ingrowth of vessels into the lesion.

In the final two sets of experiments, the first exposure was given only after ingrowth of new vessels had already become well established, about the 4th or 5th day following the NaOH injection. Two series of animals were treated, one given weekly exposures and the other daily. The eyes exposed weekly showed marked inhibition of vascularization with 750 r and 1,000 r. Smaller dosages down to 300 r had a less striking effect. Exposures up to 1,000 r given weekly for eight weeks caused no apparent ocular injury in any of these animals.

The final experiment was similar. Irradiation was also started after the vessels had begun to invade the cornea, but exposures were given daily in dosages up to 1,000 r for 16 days. The results in this series of animals were striking. Ingrowth of the vessels into the lesion caused by sodium hydroxide was practically halted following the 3rd or 4th day of treatment. The vessels in the treated eye rarely extended beyond 1.5 mm. into the cornea, in comparison to 5.0 mm. in the untreated cornea.

Of almost as great interest as the inhibiting effect itself was the fact that exposures of 300 r were as effective when given daily as exposures of 1,000 r. In none of the experiments, however, did we observe that X ray had any effect in eliminating vessels which had already grown into the cornea. At the end of eight months, ghost vessels could still be seen in both the treated and the untreated eye extending to about their original distance into the cornea. However, the scars at the site of the NaOH injection were almost invariably less dense in the treated than in the untreated eye. The consistency of this finding suggested that the ingrowth of blood vessels into this type of lesion was certainly not curative and, as judged by the resultant scar, was harmful. It is possible that irradiation of some type might be of benefit in the treatment of alkali burns of the cornea.

Clinical investigations have been carried out during the past two-and-one-half years since the beginning of our experimental work. We have used irradiation for the following conditions: (1) Prevention of vascularization of corneal transplants, (2) prevention of vascularization following keratectomy, (3) recurrent pterygium following surgery, (4) certain types of vascularizing keratitis, (5) sclerosing keratitis, (6) conjunctival neoplasm, (7) vernal catarrh.

The evaluation of clinical results following any type of irradiation, unless the results are spectacular, is extremely difficult. It is impossible to predict the normal course which any clinical condition might take in an individual patient. A condition that might become extremely severe and aggravated in one patient might clear very quickly with no treatment in another.

We also know that corneal vascularization tends to regress spontaneously following the healing of any corneal lesion. Even in corneal transplantation, where we have an ideal place in which to observe the development of blood vessels, invasion of the graft might occur during the first few weeks following surgery and then clear spontaneously. In some patients this tendency to invade is very severe and in others practically does not exist. Evaluation of the effect of irradiation is therefore extremely difficult and uncertain.

Clinically, we have employed two general methods of treatment. Until recently, 400 r to 500 r have been given to the treated area of the eye at 3- to 4-week intervals. The size of the portal has varied with the extent of the area to be treated. Localization of exposure is not difficult. Pontocaine is instilled into the eye and a speculum inserted. The patient fixes on an object with his other eye, directing his gaze in a manner which facilitates contact of the Philips tube with the

area to be treated on the fellow eye. The procedure is painless except in photophobic patients.

In our later clinical work, we have begun to utilize information derived from our experimental observations. Exposures of 200 r were given every other day for 3 or 4 days and more recently daily for 5 or 6 days. These amounts fall well within the limits of safety found in our experimental work and even that of Poppe.

It is our impression that low-voltage irradiation given in this manner can, to a great extent, prevent vascularization of corneal transplants. This has been particularly true with repeated small exposures. The same is true in corneas following keratectomy.

It is our clinical impression that very small blood vessels can be obliterated by X ray but not the larger ones, such as has been reported by men working with beta irradiation. We are not certain whether failure to close vessels may be due to dosage, for as yet we have kept our clinical dosages extremely small to protect against possible injury to the lens.

We are hopeful that with the larger dosages, as can be safely given with the new Bracke-Seib (10 K.V.) machine, the same can be accomplished as with beta irradiation and that sufficiently large dosages will obliterate even the larger vessels. Certainly, with this newer apparatus, the limits of tolerance of exposure to the cornea can be reached with extremely slight danger to the lens.

VIII. Conclusions

1. Exposure of the normal rabbit eye up to 2,000 r can be given weekly for as long as five weeks with no apparent damage to the cornea or lens being found during the following three-and-one-half months.

2. Exposures limited to the cornea with dosages as small as 500 r, when given weekly for 21 weeks, resulted in transient corneal opacity. Dosages of 5,000 r, given in the same manner, caused permanent corneal opacity and irradiation cataract, first observed 14 months following the first exposure.

3. Vascularization induced by intracorneal sodium-hydroxide injection can be markedly inhibited by low-voltage X rays. Daily exposure is more effective in inhibiting corneal vascularization than exposures given at longer intervals. Small dosages of 300 r are as effective as larger ones up to 1,000 r.

4. Exposures of 400 r and 500 r repeated 3 and 4 times at approximately four-week intervals have been used clinically in several hundred patients without evidence of cataract formation. These patients have been observed for as long as two-and-one-half years following treatment.

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Discussion

Dr. Richard H. Dennis (Philadelphia): I cannot add much to this, but I would like to point out that the infiltrate seemed to be uniformly lessened in the lesions which were treated with X ray. This suggests that we might clinically apply this type of treatment to alkali burns of the cornea. As a matter of fact, I believe Dr. Scheie is doing so with a Valley Forge patient.

Secondly, I would like to emphasize something that Dr. Gundersen has pointed out—the questionable value of blood vessels in repairing lesions in the cornea. In view of the fact that the scarring appeared less than in those which had been treated with X ray, it seems that at least the vessels were not necessary for reduction of the infiltrate. In fact, it may be that they are actually harmful.

DR. WILLIAM HUGHES (Chicago): In connection with the last comment that it may be possible to reduce the amount of residual scarring by early X-ray treatment of chemical burns to prevent corneal vascularization, I think it should be recognized that in any caustic burn, such as alkali, one already has a certain amount of corneal necrosis, and the main action of irradiation, of course, is to accentuate the death of cells and corneal necrosis.

Dr. Charles Iliff and I, in Baltimore, and Dr. Fred M. Wilson in Chicago, have found that the early use of radon in attempting to prevent the vascularization of corneas after alkali injection in rabbits usually made the lesions worse. We attributed this to the additive effect of the corneal necrosis of the alkali to that from the radiation.

I would also like to ask how easy it is with the authors' X-ray apparatus to localize the radiation accurately to the lesion to be treated.

DR. RICHARD C. RIPPLE (Philadelphia): With the Philips contact machine you can place the cone against the cornea in any position you wish. We use the lighted field to the side. It can be positioned quite accurately, and it is fixed with a series of arms that screw up tightly so that it will not move. The patient's face is fixed against the front of the bar, and the chin also is fixed. If he keeps his eyes still, you can accurately localize it to one area.

On the Bracke-Seib machine we have specially built cones that have a Y-shape with a light on one side and a peephole on the other. The patient is lying down with the speculum in the eye, and we have a lighted field that comes right down on the cornea exactly where we want it. The localization is much more accurate than with the Philips.

SYNDROME OF VOGT-KOYANAGI*

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The syndrome of Vogt-Koyanagi presents a bizarre collection of signs—nontraumatic bilateral uveitis, vitiligo, poliosis, alopecia, and dysacousia—which may occur in several combinations. Although it has been reported several times, the complete syndrome has been so rare that the opportunities for investigation of the etiology, for examination of the pathologic processes involved, and for study of therapy have been rare and these three fundamental questions remain, as yet, unanswered.

Too often special studies of the initial stage of the disease are not done because the ophthalmologist believes that he is dealing with a case of chronic uveitis, since this symptom precedes the other signs by weeks or months. In many ways, the syndrome of Vogt-Koyanagi resembles sympathetic ophthalmia and it may not be unreasonable to suggest a common etiology for both diseases.

It seems certain that, if the older observers had been aware of the peculiar combination of symptoms, many more cases of this syndrome would have appeared in the literature. Reports of the association of two or more of the symptoms date back many centuries, but it was not until 1906, when Vogt[1] reported a case of idiopathic uveitis associated with poliosis, that it began to be suspected that the sum of these signs might constitute a disease entity. It is interesting to note that alopecia was also present in Vogt's case. However, his indifferent mention of this symptom leads one to believe that he considered it merely coincidental.

The first major contribution to knowledge of this disease was made by Koyanagi,[2] in

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1929, when he reported his observation of six cases and also reviewed the findings in 16 others. Ten years later Babel[3] suggested that the combination of signs be known as Vogt-Koyanagi's syndrome.

Carrasquillo,[4] in 1942, in an excellent paper reviewed the literature and is responsible for introducing the syndrome under its present name in this country. Hague,[5] in 1944, in an equally brilliant paper ascribed the disease to a virus and placed the seat of the pathologic process in the hypothalamus.

The syndrome has been reported from all parts of the world. There appears to be no racial predilection. The sexes are equally affected. Most of the cases have occurred in the age group of 30 to 40 years, although Parker[6] has reported it in a patient, aged 10 years. The incidence of tuberculosis and lues is not increased in these patients.

Hague pointed out that the syndrome has always been initiated by one of the following conditions: an upper respiratory infection which he believed to be part of an encephalitis, severe emotional trauma, or a tumor pressing on the hypothalamus.

The most typical sequence of events consists of an influenzalike onset which includes mild fever, headache, lethargy, general malaise, and, occasionally, marked somnolence. The patient then complains of some blurring of vision and considerable pain in the eyes. Typical signs of uveitis develop almost simultaneously in both eyes and the vision rapidly diminishes to finger counting or even to complete blindness. All cases show a slow regression which varies in degree. However, in most cases useful vision is not regained.

Spinal tap, when done early, reveals a pleocytosis consisting of lymphocytes and there is increased protein. In some cases it may be possible to demonstrate a papillitis, depigmentation of the choroid, and retinal exudation. Too frequently, however, the media become cloudy and render ophthalmoscopy unsatisfactory. One to four months after the onset, alopecia appears and poliosis and vitiligo soon follow. The dysacousia is usually bilateral and may occur at any time after the onset.

Uveitis

The uveitis is bilateral and nontraumatic. It is associated in most cases with excruciating pain. Visual acuity rapidly diminishes and then there is a slow, partial recovery of sight to, in some instances, 20/40. However, it is distressing that most patients are left with a highly marked impairment of vision or total blindness.

The pathologic findings in the few cases examined have shown no differences from those seen in sympathetic ophthalmia.

Much can be done in the early stages to prevent the occurrence of posterior synechias. The complications are: secondary glaucoma, retinal detachment, cataracta complicata, and atrophy of the globe. In the early stages, beginning patches of depigmentation are visible in the chorioretina. Transillumination will also demonstrate pigmentary lapses in the anterior uvea. Later the depigmentation becomes quite universal.

Dysacousia

According to Carrasquillo,[4] who reviewed the largest series of cases, dysacousia was the least common accompaniment of the syndrome, although it occurred in 50 percent of the cases. This symptom may occur at any time but appears to follow the onset very closely in most cases. The patient notes an annoying tinnitus and he may also complain of hyperesthesia to noises. Finally he notes that he is becoming deaf. The deafness is almost always partial. Although usually bilateral, unilateral cases have been reported. According to Hague,[5] the deafness is usually temporary, persisting for several months.

The tinnitus is more annoying and less transient. This is the only symptom referable to a nonpigmented tissue. However, Peters,[7] who postulated an allergic basis for the syndrome, held that there is pigment in the basilar membrane of the labyrinth and

the disintegration here is similar to that seen in the uvea. This has never been confirmed. Also, in normal individuals pigment has never been demonstrated in the inner ear.

Calogero[8] offered another theory. He mentioned that filaments of the sympathetic carotid plexus enter the uvea and some also reach the labyrinth. Irritation of filaments in the choroid are said to cause disturbances in the branches going to the inner ear.

Alopecia

This symptom occurred in 53 percent of Carrasquillo's cases. This is frequently the first sign following the uveitis, occurring 1 to 4 months after the onset. Most cases are areata in type although there may be more generalized loss of hair. This may or may not be permanent. Areas of vitiligo often show alopecia. Alopecia has commonly been associated with emotional trauma. It is also known to occur in certain brain lesions close to or within the hypothalamus. Koyanagi stated that the immediate cause was deficient nutrition of the affected areas.

Poliosis

This is the most common associated symptom. It occurs in 82 percent of the cases according to Carrasquillo. As in alopecia, the whitening may be permanent or temporary. Hague states that, when the poliosis is secondary to alopecia areata, it may not be permanent but, when unassociated with the areas of alopecia it is always permanent. Poliosis is frequently associated with vitiligo.

According to Ormsby[9] the cause of poliosis may be: heredity, deficient innervation of hair follicles, functional (for example, fright) and organic nerve conditions (for example, facial atrophy). Sudden appearance of poliosis is usually neurogenic. There have been well-authenticated reports in the literature of poliosis initiated by a harrowing experience. Less authenticated but more dramatic was the whitening of the hair shown by Marie Antoinette when sentenced to die. The poliosis may appear in the hair, on the scalp, or on the brow. Less striking but more characteristic is whitening of several or all of the eyelashes.

Vitiligo

Carrasquillo listed this symptom in 62 percent of the cases. This condition has also most frequently been attributed to a neurodermatosis. Usually it follows soon after the alopecia. It occurs most typically in the region of the brows and eyelids. However, it has been seen on the trunk, scalp, limbs, and genitalia. Becker and Obermayer[10] attribute this to a functional derangement of the melanoblasts at the epidermoneural junction. As with the other symptoms, this may or may not be permanent. It has been seen following trauma (concussions), mental shock (depressions), and obstetrical labor, and has been associated with hysteria.

It is interesting to note that many of the cases show a strikingly symmetrical involvement of the various tissues.

Etiology

The etiology of the Vogt-Koyanagi's syndrome remains unknown. The most popular concepts are allergy, virus infection, and endocrine disturbance.

The allergic theory was postulated by Peters,[7] in 1912. He advocated an anaphylactic basis for sympathetic ophthalmia. As already mentioned, he believed there was a disintegration of the pigment in the basilar membrane causing the dysacousia. Thus, since all the symptoms occur in pigment-containing tissues, destruction of uveal pigment gives rise to an antigen capable of antibody formation. Consequently, destruction of pigmented tissues as part of an anaphylactic reaction is the result. The theory received partial confirmation by Weskamp[11] and Cramer.[12]

Cramer injected blood removed from an enucleated human eye afflicted with sympathetic ophthalmia into rabbits. The rabbits showed a marked loss of hair. However,

skin sensitivity tests have given variable results. The theory still lacks adequate experimental verification.

The endocrine theory more closely corresponds with Hague's views which place the site of the lesion in the hypothalamus. Recently Hague explained the syndrome on the basis of a virus infection which produces pathologic conditions in the hypothalamus. He showed that the influenzalike onset in many cases appeared to have been a true encephalitis. He stated that a prodrome consisting of headache, mild fever, general malaise, somnolence, or a disturbance in the sleep rhythm, visual disturbances, choreiform movements, or even paralytic symptoms of the extremities is due to an encephalitic process.

Spinal tap done early reveals a pleocytosis consisting of lymphocytes, increased albumin and globulin. This is also seen in Harada's disease (bilateral uveitis, bilateral retinal detachment, and spinal-fluid changes) which may be an early stage of this syndrome. A virus etiology in Harada's disease has also received much confirmation.

Hague, in his excellent monograph (1944), stated that a lesion in the suprachiasmic region could account for every symptom of the disease. He reviewed the evidence for the existence of anatomic and functional relationships between the retina and hypothalamus. A striking example is the retinitis pigmentosa seen in the Laurence-Moon-Biedl syndrome, a hypothalamic disorder.

Pigmentary changes are known to occur in hypothalamic lesions. The hyperglycemia and hypocholesterolemia seen in Aten's[13] case could be explained by hypothalamic-pituitary upset as can the cryesthesia seen in Gilbert's[14] case. The association of emotional trauma or encephalitis with the prodrome does not detract from hypothalamic localization. In addition, sympathetic inflammation has been seen during menstrual periods or with ovarian dysfunction. It has also been seen at puberty, regressing after the onset of menstruation.

Strong support for the hypothalamic theory is the case of Vonderahe and Abrams[15] reported in 1934. An ependymoma of the third ventricle pressing on the hypothalamus produced alopecia, poliosis, vitiligo, dysacousia, nocturia, polyuria, impotence, lethargy, and pigmentary changes around the eyes.

Pupillography has proved of value in diagnosing hypothalamic disorders. However, the early retinal destruction and iris atrophy in this syndrome make pupillary movements too bizarre to be of any value.

Case report

History. V. O., a 44-year-old unmarried Negress, first visited the City Hospital clinic on March 27, 1947, with the chief complaint of severe pain in both eyes and blurring of vision for three months. There was no history of syphilis, tuberculosis, influenza, somnolence, and so forth.

Visual acuity was: O.D., 20/40; O.S., 20/30. The right eye revealed the presence of an acute iridocyclitis. There was a four-plus flare. There were posterior synechias inferiorly. The left eye was normal. The patient was put on atropine therapy and a complete workup was ordered.

Laboratory findings. Blood Wassermann was negative. Chest X-ray study was normal. Accessory nasal sinuses transilluminated well and appeared normal on X-ray examination. Frei test was negative. Brucellergen skin test was negative. Gynecologic examination was negative. Blood count and urine examination were within normal limits. There was a slightly elevated blood sedimentation rate. At the dental clinic many carious teeth were found. Extraction was delayed until the patient underwent a course of penicillin therapy of three weeks' duration; 300,000 units per day were injected.

Second eye examination. The patient

missed her next appointment at the eye clinic and did not return until one month after her first visit. The right eye now showed many more posterior synechias and the aqueous flare was still four-plus. She was continued on local atropine and systemic penicillin therapy. Twelve teeth were extracted. On May 8, 1947, five weeks after her first visit, her vision was: O.D., 5/200; O.S., 20/30. However, many of the posterior synechias were beginning to free. On July 1, 1947, there was no aqueous flare, the eye was white, the pain was gone, and the iris was free.

One month later, August 5, 1947, the left eye suddenly became involved with an acute iridocyclitis. There was a four-plus flare and a minimal flare reappeared in the right eye. She was hospitalized for two months receiving large amounts of penicillin and typhoid vaccine. One week after discharge she noticed that her hair was beginning to fall out. It did not come out in patches but in a more universal manner. The axillary and pubic distribution were uninvolved.

On October 30, 1947, the visual acuity was: O.D., 5/200; O.S., 12/200. At this time she was only receiving atropine. On December 30, 1947, there was no aqueous flare visible in either eye. However, she had a bilateral conjunctival inflammation with stringy exudates and pale conjunctivas. The patient was switched to scopolamine.

Several days later she began to notice that small patches of skin over her eyelids were turning white. After two weeks, she gave the appearance of one wearing white goggles (fig. 1). On her next clinic visit it was noticed that several of her eyelashes were white (figs. 2 and 3). There were about 10 to 15 white lashes on each side. On further questioning the patient disclosed that she was having difficulty hearing. Otoscopic examination revealed old scarred tympanic membranes.

In March, 1948, she stopped losing hair and her hearing improved considerably.

Fig. 1 (Jaffe). Vitiligo typical of the Vogt-Koyanagi syndrome. Note the symmetry of the skin lesions.

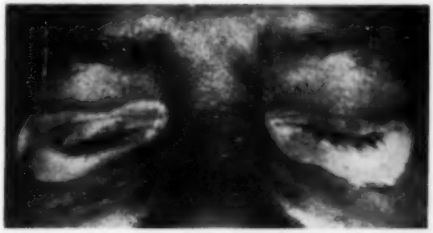

Fig. 2 (Jaffe). Vitiligo and poliosis in the same case as shown in Figure 1.

Fig. 3 (Jaffe). Poliosis of the right eye.

She remained on scopolamine therapy. There was no change in the vitiligo or the poliosis. Her vision remained poor until August, 1948, 20 months after the onset, when she noticed a decided improvement. Her visual acuity had increased to: O.D., 20/200; O.S., 20/100. At present the patient is more concerned with her vitiligo than her disturbed vision.

Comment

Unfortunately, this case was not recognized as belonging to the syndrome of Vogt-

Koyanagi until the alopecia developed. Consequently, a spinal tap was not done. Nevertheless, it represents as typical a case as any which has been previously reported. As mentioned before, there have been very few reports of cases exhibiting the entire syndrome. This case falls into that category.

Nothing conclusive can be said concerning etiology since the onset was nonspecific. There was no emotional trauma or organic infection. The onset of uveitis was followed shortly by a rapid decrease in vision. Fortunately, the patient regained useful vision. The alopecia was the next sign, although it was not areata in type. The alopecia ceased and the hair grew in again. The dysacousia also disappeared completely. The vitiligo and poliosis are the only signs which at the moment show no signs of regression (two years after the onset of the illness).

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Ophthalmic Miniature

The eye has always been held the choicest gift of Nature—the most marvelous product of her plastic force—dwell on its penetrating power, on the swiftness of succession of its brilliant pictures, and on the riches which it spreads before our sense.

Helmholtz.

THE PRINCIPLES OF SURGERY ON THE EXTRAOCULAR MUSCLES

Part II. Choice of operation in concomitant strabismus: Vertical muscles; paralytic strabismus; the phorias

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Vertical muscles

What has been said so far relates to the surgery on the horizontal muscles. Essentially the same rules apply to concomitant hypertropias. However, the vertical muscles with their more complex action present a very special problem and the difficulties to both patient and doctor arising from improper operations can be very great. Nowhere is experience more necessary than in the operations on the vertical muscles. Nowhere is individual consideration of the cases more necessary, and nowhere can fewer general rules be given. It is understandable that not a few competent eye surgeons prefer to leave the vertical muscles alone altogether.

Here, as in the operations on the horizontal muscles, recessions are more effective than resections. But greater care has to be exerted to avoid an overeffect. The reasons are that excessive or deficient excursions are less pronounced in the vertical direction than in the horizontal, and that the angle of vertical deviation is usually much smaller than in the horizontal direction.

Recessions of 3 to 4 mm. and resections of 6 to 8 mm. are the outside limit in the ordinary cases.

Two other points must be made regarding the vertical muscles. When operating on these muscles one must always keep in mind that they have a cycloductional effect, and that a strengthening or weakening of their action may produce a cyclophoria which may become very disturbing to the patient. Luckily, this component is less pronounced in the rectus muscles than in the oblique muscles.

Furthermore, there exists the well-known close connection between the superior rectus muscle and the levator palpebrae superioris. Operations on the superior rectus muscle produce, therefore, a widening or narrowing of the palpebral fissure which may become cosmetically disturbing. On the other hand, operations on the inferior rectus muscles may upset the balance in the lower field of fixation which is so much more important than the upper field of fixation and cause the patient much distress. I nevertheless prefer, in general, to work on the inferior rectus muscles. But again, as has been pointed out, experience and careful individual consideration are of paramount importance in the choice of surgery on the vertical muscles.

Finally, we have to consider combinations of horizontal with vertical deviations. The vertical deviations may be either concomitant or paralytic. In either case one should follow the rules laid down for the cases in which only a horizontal or only a vertical deviation exists. But the question arises whether the vertical or the horizontal deviation should be tackled first or whether both should be tackled at the same time.

It is said that the vertical deviations are often the cause of the horizontal deviation and should, therefore, be removed first, since the horizontal deviations tend to disappear, if the vertical deviations are removed. I have not been able to convince myself of the soundness of this rule.

There is no doubt that vertical deviations, presenting a gross obstacle to fusion, in a small child may be the immediate cause of a horizontal deviation which increases in the course of time. However, I have never seen that the horizontal deviation disappeared

when the vertical deviation was removed, if there was a considerable disproportion between the vertical and horizontal deviation, the horizontal being much larger than the vertical, as is the rule.

In these cases it is better to operate first on the horizontal muscles. If, however, the vertical deviation is very large, compared to the horizontal, and obviously the more prominent feature of the case, one is justified in operating first on the vertical muscles.

This occurs most frequently in the overaction of the inferior oblique muscle. It is at times so marked that it is indicated first to perform a myectomy of the inferior oblique muscle and to await the effect of this operation before operating on the horizontal muscles.

Here, too, judgment and a thorough examination are necessary. An overaction of the inferior oblique may have various causes. It may be due to an actual enlargement of the field of fixation of the inferior oblique muscle, that is, a true overaction of the muscle; or it may be secondary to a weakness of the superior oblique muscle of the same side or to a weakness of the superior rectus of the opposite eye; or there may be only an apparent overaction, an upshoot on adduction, due to a skew insertion of the internal rectus muscle.

Because of these various possibilities, I generally like to work first on the internal rectus before tackling the inferior oblique. Only if the overaction dominates the clinical picture and is obviously secondary do I start with the myectomy. In these cases one is often justified in doing a myectomy of the inferior oblique and a recession of the internal rectus at the same sitting. The combination of operations on horizontal muscles with a myectomy of the inferior oblique is also permissible in divergent strabismus, where an overaction of the inferior oblique muscle is never simulated by an overactive internal rectus with skew insertion.

Surgical procedures in paralytic strabismus

The primary or secondary overaction of the inferior oblique muscles is a noncomitant condition and it brings us to the discussion of the surgical therapy of paralytic strabismus.

In paralytic strabismus we have first of all to distinguish between acute paralyses on the one hand and inveterate or congenital paralyses on the other hand. In congenital paralyses, one may operate as soon as they come to one's attention. In acute paralyses, however, one must treat, before everything else, the underlying cause. When this has been done and the final and permanent outcome has been established, then one is justified in considering surgical correction. In traumatic paralyses, for instance, I wait at least six months, preferably longer (up to one year) before operating.

If the condition has become more or less concomitant, the same surgical rules apply as in concomitant strabismus.

If the deviation is still definitely paralytic, two ways are open. One can either operate on the paralytic muscle itself and its antagonist, or on the associated muscle of the other eye.

In principle, I favor working on the paralytic muscle and its antagonist, because this alone can insure the final goal of all operations on the extraocular muscles, to normalize the rotations, but in practice this is not always possible.

Operations for ocular muscle palsies may be required for cosmetic reasons, if there is a paralytic strabismus (that is, a contracture of the antagonist) in primary position, or to increase the field of binocular fixation in the direction of the paralyzed muscle.

In a congenital paralysis of the external rectus muscle, for example, there may be a marked contracture of the antagonist and a disfiguring internal strabismus. Here one may recess the internal rectus muscle and

resect the external rectus muscle to bring the visual lines into parallelism in primary position. If the visual lines are parallel in primary position to begin with, one should not recess the internal rectus muscle. If the external rectus muscle is absolutely paralytic, the only means of restoring abduction to the eye is some type of transplantation operation. If the muscle is only paretic, and if an esotropia in primary position warrants surgery, one may obtain sometimes surprisingly good results as to the motility of the eye by shortening operations on the external rectus muscle, such as resections or tuckings.

Similar considerations apply to paralyses of the internal rectus muscle.

If a superior oblique is paretic, its antagonistic inferior oblique is almost invariably overactive. A myectomy of that inferior oblique is usually very effective in reducing the hypertropia. It is also an excellent means of curing an ocular torticollis. If the myectomy was not sufficient or if there was no overaction of the inferior oblique, the inferior rectus of the other eye may be recessed with excellent result.

If an inferior oblique is paretic, a weakening of the superior rectus of the other eye can be done. If this paresis is accompanied by an overaction of the ipsilateral superior oblique, a tenectomy of the superior oblique may be done. This operation, suggested by Berke,[1] is extremely simple and the results with it are very encouraging.

A paretic inferior rectus may be resected and, if desired, its antagonistic superior rectus recessed. A recession of the inferior rectus of the opposite eye at a later stage is often helpful. Conversely, a paretic superior rectus may be resected and its antagonistic inferior rectus recessed. A resection of the inferior rectus of the opposite eye may be added later on.

Surgical procedures in heterophoria

The last, but not the least important, group of patients which has to be considered is the large group of patients with heterophoria.

The conditions in these patients differ in many respects from the conditions found in patients with concomitant and paralytic strabismus. These patients have more or less perfect binocular vision; they have no cosmetic defect; they have no gross anomalies of the rotations. In contradistinction to the patients with concomitant strabismus, they complain of subjective symptoms.

The nonsurgical means of treatment—refractive corrections, exercises to improve the fusional amplitudes, the wearing of prisms—all have their limitations, and one often has to resort to surgery. I am aware that at some of the foremost centers of ophthalmic practice little or no surgery is being done on patients with heterophoria and I am, therefore, all the more emphatic about the benefit which surgery can bestow on these patients.

In patients with heterophoria, as a rule, there is no significant excess or deficiency of the rotations. In accordance with the general principles which I have laid down for this type of patient, I rely almost exclusively on operations which strengthen the action of the muscles (resections, advancements, tuckings, or the like).

Exophoria

Surgery is most frequently required in exophoria. This is also the type of heterophoria in which the most gratifying and, from the patient's point of view, most spectacular results are achieved. It is impressive to witness the relief which these patients obtain. Not only are their symptoms of eyestrain relieved, but their whole life may be beneficially influenced. These patients are often highly nervous, irritable, and fatigued, largely owing to the exhaustion caused by the constant effort of excessive convergence. After the operation they are more relaxed, less easily fatigued, free from eyestrain, able

to perform close work comfortably, and through all this much happier people.

The operation of choice in exophoria is a resection of one, or preferably both, internal rectus muscles. The resections have to be large enough (10 to 12 mm.) to produce an immediate postoperative overeffect which soon reduces itself. If the degree of exophoria is very high, the muscles may also be advanced, or a careful recession of one external rectus muscle added.

The plan recommended here of operating more or less exclusively on the internal rectus muscles for all types of exophoria is in contrast to the usual practice and requires some discussion. The rule which is generally advocated and repeated more or less uncritically in most textbooks, is that the external rectus muscles should be recessed if the exophoria is greater in distance fixation than in near vision, and that the internal rectus muscles should be resected or advanced if the exophoria is greater in near vision than in distance vision. In other words, in the presence of poor convergence one should strengthen the action of the internal rectus muscles, while the action of the external rectus muscles should be weakened if convergence is good. This has been more or less taken for granted since the days of Landolt.

Landolt was the first to give thorough and thoughtful attention to the relation of the fusional amplitudes to the choice of operation in exophoria.[2] He established a number of categories of patients, taking into account the total range of fusional amplitude, the amount of positive and negative convergence (divergence), and the ratio of the two. If the patient had normal amplitudes or if convergence was deficient, he advocated advancements of the internal rectus muscles. If the amplitude of divergence was large, recessions of the external rectus muscles were permissible, but he warned strongly against them if the amplitude of divergence was small.

The first point which I wish to make is that the fusional amplitudes have no clinical meaning unless they are correlated with the amount of the patient's heterophoria, an essential item which Landolt does not mention in his case reports.

If a patient has, say, 8^{Δ} of prism convergence and 22^{Δ} of prism divergence for distance, it makes a considerable difference in evaluating these figures if one knows what the fusion-free position is. If this patient has 18^{Δ} of exophoria for distance, I consider his amplitude of convergence to be normal, since he has to overcome 18^{Δ} of exophoria to bring his visual lines into parallelism. This patient does not have a divergence excess; he has 26^{Δ} of convergence, namely 18 + 8, and 4^{Δ} of divergence. We must think of the fusion-free position as the zero position of the eyes; the zero of the rotary prism has no clinical or physiologic meaning.

If the patient is operated upon and the fusion-free position (or zero position) of his eyes is subsequently orthophoria, one may find after the operation, just as before 26^{Δ} of convergence and 4^{Δ} of divergence. The range of the fusional amplitudes has not been changed, but the zero position of the eyes has been shifted; it coincides now with the zero of the rotary prism. The distance of the nearpoint of convergence has shifted automatically with it.

It is not always true that the range of convergence remains unchanged after the operation. Landolt describes a case in which no change took place and I have seen a number of them. More frequently, however, the amplitudes change in the direction of an increase in positive convergence. This is what one would expect. The improved position of the eyes enables the patient, in the course of time, to increase his amplitude of positive convergence. But some time has to elapse for this to occur, and it is important to note, in evaluating the fusional amplitudes, how long ago the operation was performed. The type of operation performed has no bearing on this result.

Keeping in mind that all we can and wish to achieve in operating for heterophoria is to change the relative position of the eyes, it is evident that the choice of operation depends not on the fusional amplitudes, but on the question as to which type of operation is best suited to bring about this result. Since, as a rule, there are no gross deficiencies of the rotations of the eyes in cases of heterophoria, operations which strengthen the muscle action are the operations of choice.

For, as in exotropia, it is immaterial how the change in the zero position of the eyes is brought about, as long as the operation does not cause a disturbance of the motility. The claim that insufficient convergence is the result of an actual weakness of the internal rectus muscles, or that excessive divergence is due to excessive strength of the external rectus muscles is expressly made by Landolt, but such a mechanistic approach should surely be abandoned by the ophthalmologists of today who have learned to regard the convergence-divergence relationship as an innervational function, not dependent, within limits, on the strength of the extraocular muscles.

Since the convergence-divergence relationship is an innervational factor, one should not operate for a functional convergence insufficiency. This should be obvious, but actually operations are being done for this condition. When a patient has a small exophoria for distance (2 to 5 or so) and a large exophoria for near (say 20), he is not a suitable case for surgery. If the position of the eyes is changed by an operation, the result would be an esophoria for distance and the same relative exophoria for near. Surgery does not change the patient's ability to converge. This can only be done by training the convergence faculty.

While true convergence insufficiencies are unsuitable cases for surgery, one must guard against diagnosing a simple convergence insufficiency in exophoric patients with high ability of keeping the eyes straight in distance vision. Such patients may prove to have a large exophoria for distance, kept hidden by an effort of convergence sufficient to keep the eyes more or less straight for distance, but insufficient to overcome the exophoria at near.

The interruption of fusion in the routine tests for the heterophorias is not sufficient in these cases to relax the compensatory innervation, all the more since patients often try to "help" the doctor by consciously keeping their eyes straight.

To arrive at a more correct reading it is advisable to occlude one of the patient's eyes for some time, and one often finds then that the exophoria for distance increases a great deal. It is not always necessary to perform a prolonged occlusion test. Frequently it is enough to occlude one eye for 20 minutes, measure the patient, occlude again, measure once more and continue this until no further increase in the exophoria is noted.

Hyperphoria

Next in frequency to exophoria, with regard to the need for surgical treatment, are the hyperphorias. Here, too, extremely beneficial results may be obtained by operation. Since these patients have binocular vision, however, even more caution is necessary in operating than in the hypertropias.

Cyclophoria and a possible disturbance of the balance of the depressor muscles in the important lower half of the field of fixation must be carefully considered. Each case presents an individual problem but, in general, I work insofar as possible on the inferior muscles, because of the effect of the surgery of the superior rectus muscle on the width of the lid fissure.

Also, in considering surgery for hyperphoria one must always be sure that a dissociated vertical divergence has been ruled out by checking the hyperphoria with each eye fixation. Dissociated vertical divergence is not a heterophoria and is another example of a purely innervational condition which cannot be influenced by surgery. I have seen

a number of cases of dissociated vertical divergence which were mistakenly operated for a right or left hyperphoria. The result was the one to be anticipated: the operation changed the level of the eyes, the zero position, producing a postoperative hyperphoria, but the dissociated condition remained entirely unchanged; each eye turned up under cover just as it did prior to the operation.

When a hyperphoria is combined with a dissociated vertical divergence one is justified in operating for the hyperphoria, but for it only.

Esophoria

One is least frequently called upon to operate for esophoria. Here again the rotations are usually normal, and I consider a unilateral or bilateral resection of the external rectus muscles to be the operation of choice.

As little as in exophoria, and for the same reasons, is there a need to differentiate for surgical purposes between the various types of cases, with normal and excessive convergence and with deficient divergence. And since the rotations are usually normal the less crippling operations which strengthen the action of the muscles are preferable. Only when there is an excess of adduction, as occasionally happens, or if the esophoria is large, should recessions of the internal rectus muscles be added.

Summary

1. Surgery on the extraocular muscles can only change the mechanical conditions; it does not influence directly the innervational conditions.

2. The goal of the surgery on the extraocular muscles should be the normalization of the rotations; where they are normal, surgery should not make them abnormal.

3. In horizontal concomitant strabismus the choice of surgery should be based on the behavior of the rotations, not on the behavior of convergence which is an innervational factor.

4. Accurate abstract rules for the dosage of these operations, based on geometric and kinematic constructions, cannot be given. Only general indications are possible.

5. The application of the general principles to surgery in heterotropia, paralytic strabismus, and heterophoria is discussed.

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SOME PRACTICAL POINTS ABOUT THE RECESSION OPERATION*

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More than a quarter of a century has passed since Jameson[2] first described the recession operation. It has been almost universally employed by nearly every surgeon who operates upon the oculorotary muscles. There is little doubt but that the medial rectus is recessed more often than any other muscle. Curiously enough, while many surgeons state that they are performing the recession operation, seldom can any two surgeons be found who perform the operation exactly alike. If there are not good reasons for so much variation in the technique for performing the operation, then it is obvious that some surgeons are not getting the maximum effect from the recession. The uncovering of several facts since the time of Jameson has, perhaps, modified somewhat the most desirable technique of the recession operation. A careful consideration of each step as it now seems advisable in the procedure of recession may prove of interest.

Some surgeons are of the opinion that the operation of recession is solely one of shifting the primary insertion of a muscle to some point more posteriorly located on the globe. If the maximum effect is to be gained from the operation, the primary insertion must be recessed while the secondary insertions must be sectioned. The secondary insertions are frequently of greater mechanical significance than the primary one. The secondary insertions include: (1) The check ligaments, (2) the intermuscular membrane, and (3) foot-plates or other insertional anomalies.

In the past, check ligaments have been ignored by many and even purposely avoided by a few, while the intermuscular membrane and the insertional anomalies have been partly destroyed. They have been damaged just enough to render them unrecognizable to many but not enough to destroy their mechanical effect. This is the obvious explanation of the tremendous variation in effect of the operation from one patient to the next, when it occurs. Lancaster[3] has already pointed out the importance of the intermuscular membrane as a secondary insertion. When a muscle is tenotomized, it does not retract indefinitely into the orbit but only for a very few millimeters because it is held in place by the intermuscular membrane and the check ligaments as well; a tenotomized muscle simply retracts a few millimeters and reattaches itself to the globe. Gifford[1] demonstrated this latter point very nicely.

The competent and skillful surgeon avoids both undue trauma to tissues and unnecessary bleeding. He also knows anatomy well enough to be able to recognize structures or anomalies immediately when they are encountered in the course of an operation.

A majority of operators make a lengthy conjunctival incision—often two centimeters long—in their attack on a muscle. They maintain that good surgery demands adequate exposure and this is true. Disagreement arises over the use of the term "adequate."

Once the conjunctiva is laid wide open, many surgeons then spend several minutes in searching for the muscle they plan to attack; these searches can be damaging for surrounding tissues. When the muscle is finally found, a hole is usually made in Tenon's capsule and the muscle is hooked. The hook is cut out on the other side of the muscle and a second hook is then passed from the opposite side.

* From the Department of Ophthalmology, Washington University School of Medicine, and the Oscar Johnson Institute. Part of a study made under contract with the Office of Naval Research as Project N6onr-202, NR141-022 Task Order I.

When both hooks are in position, the operator will frequently separate them forcibly for as much as a centimeter. This forcible separation partially destroys the intermuscular membrane and certainly destroys insertional anomalies. Meanwhile the tissues are considerably bruised and the muscle may be partially stripped of its sheath. Such a technique has nothing to recommend it, while there are many points that may be raised against it.

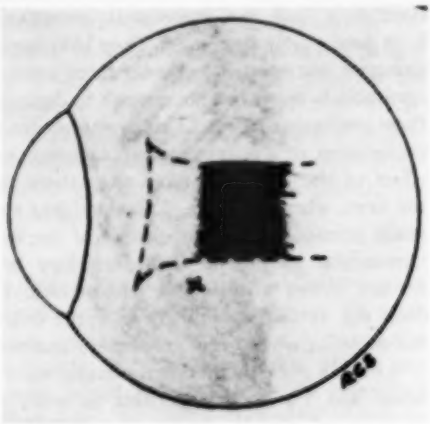

Fig. 1 (Scobee). Sketch representing the insertion of one of the horizontal rectus muscles. "X" marks the site for beginning the operation.

The technique which will be described avoids many, if not all, of the objections thus far raised. It has been used in over 400 cases and the postoperative reaction is minimal. It is easy to use, even for the inexpert surgeon, and can be quickly done. There is little or no hemorrhage and the tissues are exposed to a minimum of trauma.

Operative technique

If the surgical incision for any operative procedure on the medial rectus is made level with the margin of the plica semilunaris, the resultant scar will be practically invisible. This cosmetic point is of greater interest to the patient than to the surgeon but it is well to take it into account.

To begin the operation of recession on the medial rectus, an assistant places a muscle hook in the lateral conjunctival fornix above the level of the lateral palpebral ligament. When the hook in this position is depressed into the fornix, the globe is rotated outward and slightly upward—the position of maximum accessibility of the tendon insertion for the first step in making the incision (fig. 1). The medial rectus will be used in this paper as an example, although the same technique can obviously be applied to any of the rectus muscles with certain added modifications for the vertical recti.

When the globe has been thus rotated into position by an assistant, the operator locates a point at the plica semilunaris about two mm. below the inferior border of the medial rectus. Using a small-jawed toothed forceps, the surgeon opens the jaws about 4 mm. and presses their tips perpendicularly against the globe until a slight indentation is visible. Keeping this gentle pressure constant, the jaws of the forceps are closed firmly. The closed jaws of the forceps will include a bite of both bulbar conjunctiva and the underlying Tenon's capsule. The forceps are next pulled slightly away from the globe, the jaws being kept closed, and the

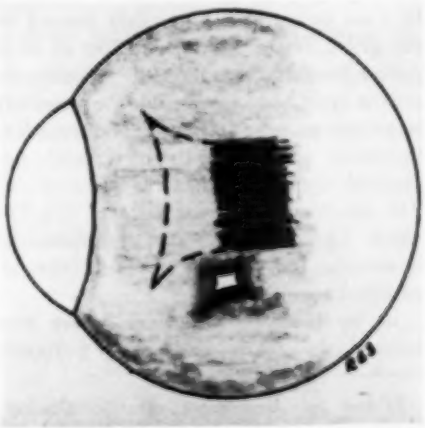

Fig. 2 (Scobee). A small nick has been made through both conjunctiva and Tenon's capsule at the site of "X" in Figure 1.

tent of tissue formed is deeply nicked in a vertical direction by means of conjunctival scissors whose blades are also held perpendicular to the globe. The resultant small slit will extend through both bulbar conjunctiva and Tenon's capsule (fig. 2), leaving bare sclera visible in the depths of the vertical opening.

The surgeon next inserts the tip of a muscle hook into the hole (fig. 3), the hook itself being aimed directly posteriorly. The hook is passed straight backward until the tip is well beyond the equator. After this is done, the hook is then swept gently upward while it is kept hugging the globe closely. As it is swept upward, it is also pulled forward and will then be halted under the insertion of the tendon. If the muscle is properly hooked in this maneuver, the hook when pulled forward will abduct the globe

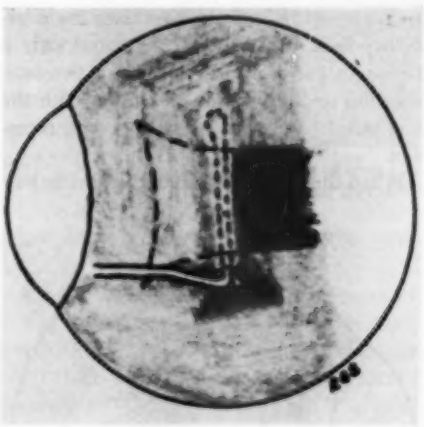

Fig. 3 (Scobee). A muscle hook is passed through the original hole. Its tip is easily visualized through conjunctiva and Tenon's capsule at the superior border of the muscle.

and this abduction is the assistant's cue to withdraw his hook from the lateral conjunctival fornix.

As the muscle is thus hooked and the globe abducted, the operator notes particularly the force required on the hook to produce full abduction, if this is possible. If the muscle seems inelastic and the globe cannot be fully abducted, this almost invariably warns the operator of the existence of anatomic anomalies preventing proper relaxation of the medial rectus—unless, of course,

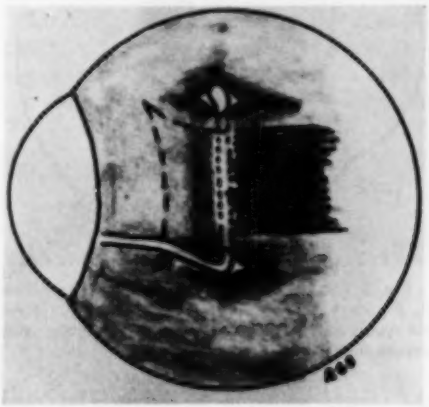

Fig. 4 (Scobee). The tip of the hook at the superior border of the muscle has been exposed by a small nick made with scissors through conjunctiva and Tenon's capsule. This leaves a bridge of conjunctiva between the two holes.

the muscle is actually fibrotic which is a rare finding indeed.

While this traction test is being made, the tip of the hook is easily visualized through bulbar conjunctiva and Tenon's capsule at the superior border of the muscle. The assistant is given the hook to hold and the surgeon picks up the bulbar conjunctiva at the tip of the hook and nicks it vertically with conjunctival scissors, allowing the capsule-covered tip of the hook to emerge through the conjunctival hole just formed. Tenon's capsule over the tip of the hook is similarly nicked and the hook tip is now completely exposed to view (fig. 4). When both conjunctiva and Tenon's capsule are nicked in the fashion described, the scissor's blades are inserted into the tiny opening in the closed position and then spread slightly to facilitate slipping the edges of the opening over the tip of the hook.

A bridge of conjunctiva is left crossing

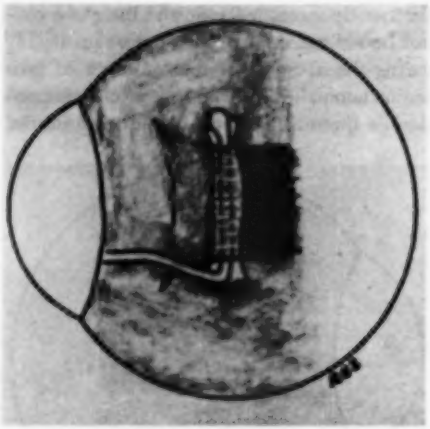

Fig. 5 (Scobee). The conjunctival bridge shown in Figure 4 has been cut, allowing the edges of the conjunctival incision to retract slightly and expose the tendon in its sheath.

the muscle tendon at its insertion, running between the two small conjunctival slits previously made—one above and one below the muscle borders. The tip of one scissor blade is inserted into one of these holes in the conjunctiva and directed toward the opposite hole. The conjunctival bridge is thus severed and the conjunctiva will then retract at each cut edge to expose muscle tendon (fig. 5). The conjunctival incision is just about one centimeter in length.

The anterior lip of the conjunctival incision is lifted up and pulled slightly forward with a toothed forceps, exposing the scleral insertion point of the muscle's tendon. Several bands of episcleral tissue are exposed running between the underside of the conjunctiva and the tendon sheath (fig. 6). These are severed with the scissors. The scissor's points, with blades closed, are then pressed gently into the sclera, indenting it just anterior to the tendon insertion and at about its midline. While the pressure is maintained, the blades are opened and the spreading of the blades completes the cleaning of the insertion by blunt dissection—the only blunt dissection in the entire procedure, incidentally.

If properly done, there is little or no bleeding. Bleeding is encountered when one cuts too close to the upper and/or lower borders of the tendon at its insertion—something that need not be done and is better left undone. The less bleeding that is encountered during the recession operation, the fewer postoperative adhesions there will be and the better the result.

The next step is the placement of the suture. Plain catgut, 3-0 double-armed, is preferable to chromic gut because the latter results in too much postoperative reaction. The suture is passed as close to the insertion of the tendon as possible and is locked at the upper and lower borders (fig. 7). If the suture is not placed as close to the tendon end as is possible, any space between the suture and the tendon end will decrease the effect of the recession by the same amount.

Thus, the careless surgeon who places sutures for a recession two mm. from the tendon insertion and then recesses the muscle five mm. has actually performed only a three-mm. recession. He has done a two-mm. resection and a five-mm. recession with the final effect being that of a three-mm. recession.

When the suture is placed, the muscle ten-

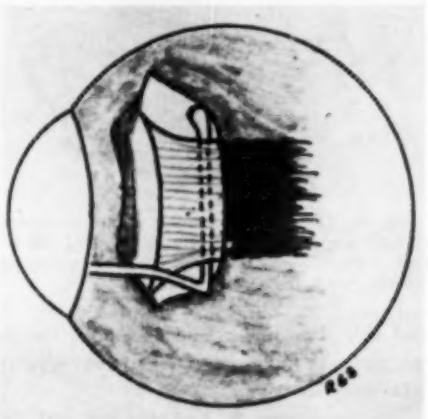

Fig. 6 (Scobee). The anterior lip of the conjunctival incision is pulled forward and the episcleral bands that run from the under surface of conjunctiva to the tendon sheath are divided. The tendon insertion is now exposed.

don may then be divided from the globe as close as possible to the insertion. This prevents the disfiguring sight of a lump under the conjunctiva at the old insertion site. Chavasse actually advised shaving the stump from the globe with a Graefe knife and the method has much to recommend it. However, the sclera is thinnest at this point—0.3 mm.—and the novice may buttonhole it during the shaving process. Scissors are much safer and, if properly used, almost as effective.

Another objection to a poorly cleaned insertion stump is that one will occasionally find patients in whom a successful surgical result will revert to a slight-to-moderate esotropia over a period of months, postoperatively; if the medial rectus is surgically explored in these cases, bands of adhesions will usually be found growing from the new insertion site (posteriorly) forward to the old site and it seems obvious that these bands, once they gain a foothold on the old stump left behind, begin to contract and thus produce a recurrence of the esotropia. Such cases never return to the amount of esotropia formerly present, however.[4]

In using scissors to divide the tendon from its insertion, it is wise to make a series of small bites rather than a single large bite, although the latter is unquestionably more dramatic. Since the globe is curved, the small bites divide the insertion at the globe more cleanly than a single large bite and there is certainly less danger of buttonholing the sclera.

Once the muscle is divided from the globe at its insertion, the sutures in the tendon serve well the purposes of traction. The muscle is pulled gently anteriorly and at the same time away from the globe. The global surface of the muscle may then be explored for the presence of foot-plates or other abnormal insertional attachments.[5] If none are seen, a muscle hook should be swept over an entire one third of the globe on the medial surface; this must be done to avoid overlooking abnormal muscle slips attached posteriorly and either above or below the main body of the medial rectus.

The surgeon next makes traction on the muscle in an anterior direction, meanwhile pulling it toward the center of the globe. The assistant gently grasps the posterior lip of the previously made conjunctival incision and, as this lip is pulled away from the underlying tissues, the check ligaments are put on a stretch and easily visualized. The surgeon cuts these with scissors as far posteriorly as they may extend, noting any

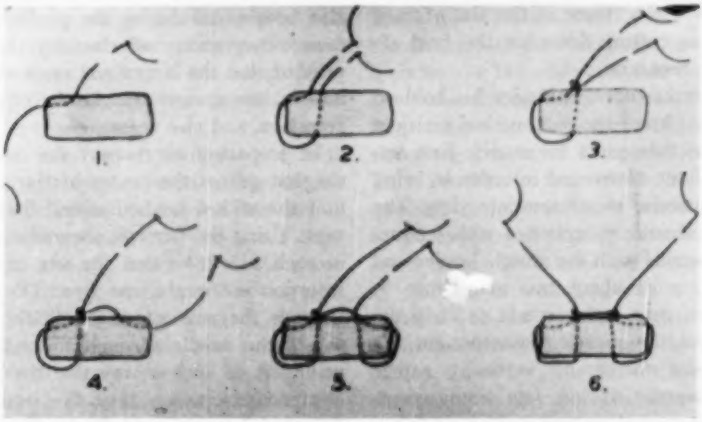

Fig. 7 (Scobee). The steps in passing a double-armed suture through the muscle tendon, locking it at each margin of the muscle.

abnormalities as he does so. When this has been properly accomplished, the surgeon may pass a muscle hook gently along the orbital surface of the muscle to a point at least one centimeter behind the posterior tip of the globe without encountering any resistance. The check ligaments should be cut fairly close to the muscle but not so closely that the muscle is stripped of its sheath. This avoidance of stripping the muscle sheath is extremely important because adhesions invariably form at the site of bare muscle, thus cutting down on the final effect of the recession.

While the assistant maintains his hold on the posterior lip of the conjunctival incision, the surgeon then pulls the muscle first upward and later downward in order to bring the intermuscular membrane into view. The membrane should be sectioned with scissors in a line parallel with the muscle border and at a distance of about two mm. from it. Here again, care is taken not to strip the sheath from the muscle. Jameson cut the intermuscular membrane vertically rather than horizontally as has just been recommended.

When the muscle has been freed completely at its upper and lower borders and on its orbital and global surfaces, and its lack of further attachments have been demonstrated by a muscle hook passed posteriorly along all surfaces, the operator may then study the elasticity of the muscle.

Traction is made on the muscle via the sutures in the tendon, pulling it anteriorly and putting it on a stretch. If the muscle has a normal elasticity, it will stretch almost like a new rubber band but, if inelastic, it will stretch for only a short distance and then stop suddenly as if one were trying to stretch a piece of twine. When this traction test of elasticity is made and noted, the suture is then released and the speed and extent of the retraction of the muscle is next observed.

When released, a normally elastic muscle should retract quickly and completely from view into the conjunctival incision; if the muscle is normally elastic and yet does not disappear entirely from view when traction is released, the surgeon may be sure that some of the attachments, either primary or secondary, have not been sectioned completely. An inelastic muscle will retract slowly and incompletely, coming to a rest with its tendon usually still visible in the conjunctival incision.

The relative size of the muscle will have also been noted during the performance of these observations of elasticity. It will be recalled that the larger and more elastic the muscle, the greater will be the effect of its recession, and vice versa.

In preparing to reinsert the muscle, the surgeon grasps the center of the old insertion site with a toothed scleral fixation forceps. Using the forceps, the globe is rotated in such a fashion that the site of the new insertion is brought into view. The assistant sponges the new site dry and the surgeon passes the needle through the sclera, tunnelling it in such a way that the needle is always visible as a grayish line seen through the overlying sclera; if the needle cannot be seen through the sclera at all times, the bite is too deep and should be withdrawn for a subsequent attempt at passing the needle.

The scleral needle bites should be taken at the new insertion site at the levels of the upper and lower ends of the old insertion; that is, at least 9 or 10 mm. apart, and in the same vertical line on the globe with each other. Proper spreading of the scleral needle bites insures proper spreading of the muscle tendon for adequate reattachment. The needle should tunnel at least three mm. in sclera for a satisfactorily firm bite.

The sutures are gently pulled tight until the muscle tendon is moved into its new insertion and seen to be properly spread. A double tie is made in the suture (the first part of a surgeon's knot) and then two additional single ties. The suture ends are cut close to the knot.

The conjunctival wound is closed accord-

ing to the preference of the operator. Many use continuous black silk sutures. Others use interrupted silk. Interrupted 3-0 plain gut is perfectly satisfactory and has several advantages. Three interrupted sutures are used. While producing slightly more postoperative reaction than does silk, plain gut nevertheless has the advantage that it does not have to be removed—a dreaded event by the patient, even when an adult. While the immediate postoperative appearance of the conjunctival closure is not as pretty and neat with the interrupted plain gut closure as with continuous silk, still one month postoperatively the incision line is invisible with either form of closure.

The first interrupted plain gut suture is placed through the conjunctival lips of the wound at the center of the incision and is tied in a square knot. One end is cut close to the knot and the other left about three cm. long. Traction made on the long end markedly facilitates the placing of the remaining two stitches—one above and the other below this center stitch in the conjunctival incision. These last two stitches are tied only once (half of a square knot). All ends are cut close to the knots.

Both eyes are bandaged, even though only one medial rectus muscle has been recessed. An undercorrection following a recession of the medial rectus for esotropia is apparent at the first dressing 24 hours following operation but an overcorrection cannot be positively diagnosed for several weeks after the same operation. If there is a slight undercorrection at the first dressing, both eyes should again be bandaged for another 24 hours. Patches are left off of the eyes after the second day and antiseptic eye drops are given for use four times daily for 10 days postoperatively.

Discussion

The technique that has been described for the recession operation is simple. It enables the muscle tendon to be located without a protracted and tissue-bruising search. The approach to the tendon is such that anatomic anomalies are left intact with the single exception of an occasional flimsy foot-plate and may thus be visualized by the surgeon. There is little or no bleeding—an important point. The entire operation requires between 10 and 12 minutes and there is very little postoperative reaction. Two points are worth further discussion.

There is one school of thought among surgeons performing the recession operation which takes cognizance of the intermuscular membrane and of the check ligaments and their section but advocates this sectioning by blunt dissection. These are usually divided by passing a muscle hook forcibly backward along the course of a muscle on all sides. This forcible tearing of the structures in question can, of course, be accomplished but at the expense of tearing the muscle sheath in spots as well. I have had the opportunity to perform a second operation on several patients where the medial rectus was freed of its secondary attachments by blunt dissection. In every instance, the medial rectus was bound to the globe by many adhesions and the recession had been rendered partially or even totally ineffective. Reëxploration of other cases where sharp dissection was used uncovered no adhesions at all. The balance of evidence is certainly in favor of sharp dissection for secondary muscle attachments.

The other point for discussion has to do with retraction of the caruncle. Jameson[2] so feared retraction of the caruncle that, although he divided the intermuscular membrane, he advised that "the areolar tissue in which the muscle is deeply imbedded in the region of the caruncle should not be sliced. If this is done, the muscle is endangered, the anatomy disarranged, and the reaction will be greater."

The surgeon who avoids the check ligaments usually gives as his reason a fear of retraction of the caruncle. A moment's reflection will reveal that this is unfounded in fact. The worst instances of retraction of

the caruncle followed free tenotomy of the medial rectus, and well they might.

The medial rectus sheath is attached by means of its check ligaments to the caruncle, to the medial palpebral ligament, and to the medial conjunctival fornix, as well as to the medial wall of the orbit. When a free tenotomy is done, the muscle naturally retracts somewhat, tensing its check ligaments against their anterior attachments, and retracting the caruncle. On theoretic grounds, one would expect less retraction of the caruncle when the check ligaments had been severed than when a recession is done and they are left intact. This is adequately borne out in a series of over 400 patients in whom the check ligaments of the medial rectus were completely divided by the technique herein described and not a single patient has a retracted caruncle.

640 South Kingshighway (10).

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CONGRUOUS HOMONYMOUS HEMIANOPIA WITH MACULAR SPARING

REPORT OF A CASE

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Mr. W. W., a white man, aged 70 years, had been in good health until August 4, 1948, when he had a sudden dizzy spell while walking on the street. He did not lose consciousness but had to hold on to a fence. The attack lasted only a minute but, since that time, vision in his right eye has been blurred and he can not see people approaching him on the right side. He has had no headaches or other complaints, only a slight feeling of pressure over his right eye and in the right side of his head. His extremities are not weak and he can walk without difficulty.

Eye examination revealed no external anomalies. The pupils were slightly narrowed, equal, round, and reacted to light promptly and with normal amplitude. Movements in all directions were normal.

Visual acuity was: O.D., 20/100, correctible to 20/30 with a +1.0D. sph. ⌒ +0.5D. cyl. ax. 180°; O.S., 20/50+, correctible to 20/30 with a +1.5D. sph. ⌒ +0.5D. cyl. ax. 180°. He had never had glasses for distance; for about 15 years he had had glasses for near.

Ophthalmoscopic examination showed some lenticular opacities but the vitreous was clear. Discs were of normal size, shape, and color, with well-defined borders. No elevation, no hemorrhages, and no exudates were present. The blood vessels showed marked arterial and arteriolar sclerosis, with concealment and compression at several arteriovenous crossings especially at those of the larger branches.

Biomicroscopic examination revealed an incipient senile cortical cataract in both lenses, with lamellar separations, a few waterclefts and opaque fibers in both cortices. Corneas, anterior chambers, irides, vitreous were normal.

Perimetric examination revealed an almost completely congruous homonymous hemianopia on the right, with a sparing of the macula and small part of the upper quadrant (figs. 1 and 2).

Neurologic consultation. The patient was

referred to a neurologist for consultation, to exclude disorders other than damage to the visual pathways. The neurologist reported that there were no abnormal involuntary movements, muscle tone and strength were normal; coördinatory movements well performed; no aphasia or apraxia was present. The deep reflexes were active and equal throughout; abdominals were normal. There were no pathologic reflexes; sensation was normal in all modalities, including touch, pain, position, and vibration. There was no facial weakness; facial sensation was normal; the tongue protruded in the midline. Mental examination showed normal sensorium, normal mental trends and emotional status.

Analysis of the case

To understand and interpret this case, we have to recall the course, the relations, and the blood supply of the visual pathways. Homonymous hemianopia is caused by loss of perception of visual impulses affecting the right or left half of each retina.

In this case all impulses coming from the left side of both retinas, that is left to the physiologic center, the macula lutea, were lost. The block may be anywhere in the left tract, or in the left external geniculate body, or in the left Gratiolet radiation, or in the left cortex. Either there is a failure of the nerve fibers to carry the impulses to the left calcarine area, or there is a failure of the cortex to perceive these impulses. The central vision however is not affected.

Because the hemianopia is congruous—that is, the defect of the field is identical in size and shape—the lesion must be above the external geniculate body. The intermingling of the nerve fibers coming from the corresponding retinal points of the two eyes is not regular until the fibers leave the external geniculate bodies. In the external geniculate bodies they commence regularity to a certain extent, inasmuch as the synapses are coupled in six separate layers one above the other. However, if a lesion is not exactly vertically placed, the hemianopia will not be congruous.

From here on, in the Gratiolet radiation, the corresponding fibers travel together until they reach the cortex in the calcarine area, where the perceiving elements are also coupled (Brower and Zeemann, Henschen,

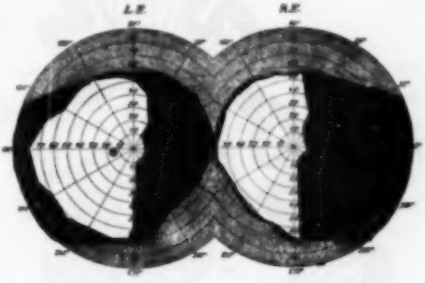

Fig. 1 (Vesey). Visual field taken on August 18, 1948, for 10-mm. white, 330-mm. radius.

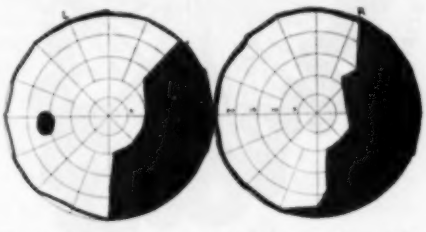

Fig. 2 (Vesey). Visual field taken on August 20, 1948, for 10-mm. white, 1,000-mm. radius.

Monakow, Minkowsky, Roenne, Putnam). The first part of the Gratiolet radiation (the nerve-fiber bundles connecting the external geniculate bodies with the cortex) is located just behind and below the internal capsule (the white matter between the thalamus and the nucleus lentiformis, enveloping the latter).

The internal capsule consists of an anterior and a posterior "limb" (fig. 3). Since the posterior limb contains the sensory fibers running from the thalamus to the cortex of the parietal and temporal lobes, and since the anterior limb contains the centrifugal pyramidal tract (the motor fibers of the voluntary muscles) and since lesions, especially vascular lesions of the anterior part of the

Gratiolet radiation, are very likely to involve either or both parts of the internal capsule, a pathologic process involving this area

Fig. 3 (Vesey). (After Bing and Haymaker). Schematic presentation of relationship between visual pathways and thalamocortical and pyramidal pathways. (L) Lenticular nucleus. (C) Caudate nucleus. (T) Thalamus. (1) Frontopontine and frontothalamic tract. (2) Occipitotemporopontine and occipitotemporothalamic tract. (a) Auditory radiation. (V) Visual radiation.

In the internal capsule: (F) Supranuclear facial fibers. (Hypog.) Supranuclear hypoglossal fibers. (Super.) Pyramidal fibers to superior extremities. (Infer.) Pyramidal fibers to inferior extremities. (S) Sensory fibers from thalamus to cortex.

would produce sensory and/or motor disturbances (paresthesias and paraplegias) homolateral with the hemiplegia (homonymous hemianopia with homolateral hemiplegia, and so forth). Lesions farther back toward the occipital cortex will, on the other hand, appear without these sensory and motor disturbances.

In their long course the optic pathways receive their blood supply from many arteries. The ophthalmic artery, the anterior cerebral and anterior communicating arteries, small branches directly from the internal carotids, the anterior choroidal artery, the middle cerebral, the posterior communicating, the posterior cerebral, the posterior choroidal, and the strong calcarine branch of the posterior cerebral artery supply different portions of the optic pathways.

In the neighborhood of the external geniculate bodies, the posterior portion of the optic tract and the anterior portion of the Gratiolet radiation are supplied by the anterior choroidal artery. The external geniculate bodies themselves are supplied partially by the anterior choroidal and mainly by direct branches of the posterior cerebral artery. The greatest part of the Gratiolet radiation is nourished by the posterior cerebral artery; the calcarine area by the strong end-artery formed by the calcarine branch.

At the occipital pole, where the macular perception is affected, there is a remarkable anastomosis between the twigs of the calcarine artery and branches coming from the middle cerebral artery, so that this area will not cease functioning in the event that the main trunk of the posterior cerebral, or the calcarine branch of the posterior cerebral, is entirely occluded by embolus or thrombosis. An occlusion might result in complete destruction of the whole calcarine area, except this important part, the pole itself.

In the case herein reported, therefore, the diagnosis of thrombosis of the calcarine artery should be accepted as the cause producing homonymous hemianopia with macular sparing.

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ALTITUDINAL HEMIANOPIA*

Report of two cases

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Visual-field defects resulting from head injuries are of frequent occurrence but the bilateral horizontal type, because of the mechanism of its production, is rather infrequently seen. The primary purpose of this paper is to report two such cases resulting from bilateral occipital lobe injuries, and to discuss the pathologic changes involving the visual pathway.

An anatomic review of the visual pathway (unilateral), as the visual impulse courses from the retina to the visual cortex, shows the structures in this order: retina, optic nerve, chiasm, optic tract, lateral geniculate body, optic radiation, and visuosensory cortex.

The optic nerves extend from the lamina cribrosa to the chiasm, and their fibers, both central (macular) and peripheral, are the axones of the retinal ganglion cells. At the chiasm these fibers decussate in part, the outer divisions passing uncrossed through the chiasm, while those of the inner halves decussate to form, with the uncrossed fibers of the opposite side, the optic tracts. The right optic tract thus contains the optic-nerve fibers from the right half of each retina, and the left optic tract those of each left half.

The optic tracts extend from the chiasm to the lateral geniculate bodies where a synapse occurs. From the lateral geniculate bodies, the visual fibers pass as the optic radiation (centripetal visual fibers) via the internal capsules to the occipital lobes where, on either side of the calcarine fissures, the visual cortex is located. Thus there is an accurate projection of the homonymous halves of the two retinas on the contralateral calcarine cortex.

Macular vision is represented near the pole of the hemisphere, and the peripheral portion of the fields more anteriorly, while the upper quadrants of the retinas correspond with the dorsal and the lower with the ventral parts of the visual cortex.

Defect or loss of the upper or lower visual half-field is termed altitudinal or horizontal hemianopia. This may be superior or inferior, unilateral or bilateral, and, if the latter, crossed or uncrossed. According to Traquair,[1] it is very rarely a true hemianopia, but usually a wide sector defect.

Theoretically, bilateral altitudinal hemianopia may be produced by the interruption, at any point along their course, of the visual fibers supplying either the upper or lower retinal halves. A single lesion could do this at one point only—the chiasm. At all other points the lesion must be bilateral. Actually the condition is rarely seen and, when it does occur, it is often the result of projected missiles passing transversely through the visual cortex. If the upper lips of the calcarine fissures bilaterally are destroyed, the lower halves of both visual fields will be lost up to the horizontal midline. Analogous cases of superior hemianopia result from destruction of the inferior lips of both calcarine fissures.

In the great majority of cases of altitudinal hemianopia seen clinically, the lower visual fields are affected. This interesting fact is, perhaps, best explained by the fact

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that transverse wounds, such as bullet wounds involving the upper portion of the visual cortex, may spare nearby vital structures; whereas, similar injuries involving the lower portion of the visual cortex usually result fatally due to the proximity of large and vital blood sinuses which are almost always simultaneously involved.

Head injuries, intracranial tumors, cere-

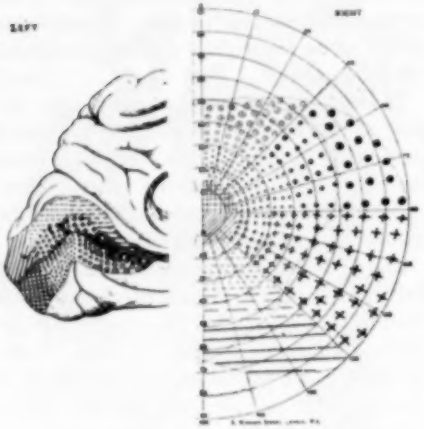

Fig. 1 (Berkley and Bussey). Diagrammatic representation of the cortical retina. (Reprinted with permission, Gordon Holmes: In Rea: Neuro-Ophthalmology, Mosby, 1941.)

bral vascular accidents, and the by-products of brain surgery have been the chief sources of information pertaining to pathologic conditions of the visual pathway. The chief weaknesses in the study of this subject have been the lack of adequate post-mortem studies of cases known to have lesions involving the visual pathway and the inapplicability, for obvious reasons, of animal experimentation to the subject.

Holmes,[2,3] Holmes and Lister,[4] and Marie and Chatelin,[5] working especially with head injuries resulting from World War I, collected valuable data and material demonstrating the relationship between field defects and visual-pathway lesions, especially those in the region of the visual cortex.

Holmes, from his investigations, came to the very interesting conclusions shown in Figure 1. This excellent diagram has been used in each of the following case reports in an effort to visualize more fully the probable cortex lesions and their projected field defect (figs. 4 and 7).

Case reports

Case 1

History. L. G. S., a 21-year-old seaman, received a severe blow to the occiput when he was knocked down by an assailant in a street altercation, and fell backward, striking the back of his head against the concrete sidewalk. Nose bleeding, vomiting, and loss of consciousness followed in rapid order.

The patient was immediately hospitalized, where preliminary examination revealed profound coma, normal temperature and respiration, pulse 64 beats per minute, and blood pressure of 130/70 mm. Hg. There was a small hematoma over the occiput. The spinal fluid was grossly bloody.

Two days later with the patient still comatose, a trephine opening was made in each posteroparietal area in an effort to locate a suspected subdural hematoma. This effort was without success and the patient remained alternately comatose and irrational for a period of 20 days.

Approximately six weeks following the injury, he was transferred to the U. S. Naval Hospital, St. Albans, New York, where reëxamination revealed a mentally beclouded and at times irrational subject, who could be aroused with painful stimuli, but on such occasions was argumentative, pugnacious, and disoriented as to time, place and person. A left lateral rectus palsy and a sustained left horizontal nystagmus were present. The superficial reflexes were absent and the deep reflexes were diminished.

Eye examination. Although vision was 20/20 in each eye, the patient nevertheless complained of blurring of vision, especially on looking upward. There was no appreciable error of refraction. Visual-field studies

revealed a well-marked and constant bilateral superior altitudinal hemianopia (fig. 2B).

Roentgenographic studies of the skull showed no evidence of fracture. Sensorium gradually cleared, and the patient became free of all complaints except the superior field defect. This, however, was considered as probably not physically disqualifying for his rate, and a trial at duty under observation was recommended. Accordingly, the patient was discharged from the hospital approximately six months following the injury.

Course. Shortly after discharge to duty, he began to experience a disturbance of equilibrium, characterized by ataxia and a tendency to drift to the left, and associated with dizziness and headaches.

This condition was worse upon arising in the mornings following which he felt a tendency to fall forward. A period of about three hours would elapse before the sensation of imbalance would wear off and an adjustment would take place. Because of these developments, the patient was again hospitalized approximately one month following his previous discharge.

Upon admission he was mentally alert, but displayed a moderate ataxia with a tendency to drift to the left, mild adiadokokinesis of the left upper extremity, and some slurring of test sentences.

The left lateral rectus muscle was now intact, and the left horizontal nystagmus previously noted could be demonstrated only in the extreme left gaze. The visual-field defect was still present, but had improved.

Encephalographic studies. Following injection of air by the lumbar route pneumoencephalographic studies in stereoscopic view showed good filling of the lateral, temporal, and posterior horns of the lateral ventricles, with the left lateral ventricle slightly larger than the right, but the septum pellucidum was essentially in the midline. The third and fourth ventricles showed filling by air. There was considerable air beneath the tentorium around the cerebellum and the basilar cistern (fig. 2A). The cerebellum showed advanced atrophy.

An electro-encephalogram with the usual leads indicated no cortex abnormalities. However, when one electrode was placed in the nasopharynx all bipolar tracings utilizing this lead were abnormal, showing large irregular alpha waves of great amplitude ranging from 6 to 9 per second and suggesting cerebellar and occipital dysfunction (fig. 3).

Fig. 2A (Berkley and Bussey). *Case 1.* Pneumoencephalogram showing air beneath the tentorium and cerebellar atrophy.

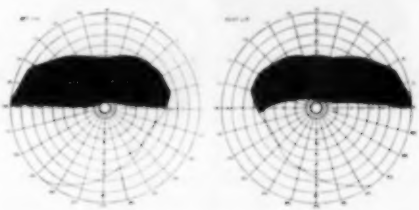

Fig. 2B (Berkley and Bussey). *Case 1.* Visual fields taken on April 11, 1947 for 5/330 white.

Comments

The findings in this case indicated a condition of old cerebellar or posterior fossa hemorrhage with resultant cerebellar atrophy and visual-cortex damage.

The visual-field defect was considered due to permanent bilateral damage to the lower

lips of the calcarine fissures (fig. 4), resulting from upward pressure from a cerebellar hemorrhage which was now resorbed. The lower portion of the visual cortex due to transverse penetrating missiles are rarely seen clinically since such injuries practically always involve other vital structures with fatal results. However, in a case such as this, where the force is from below and intracranial, the visual defect may be produced without a fatal termination.

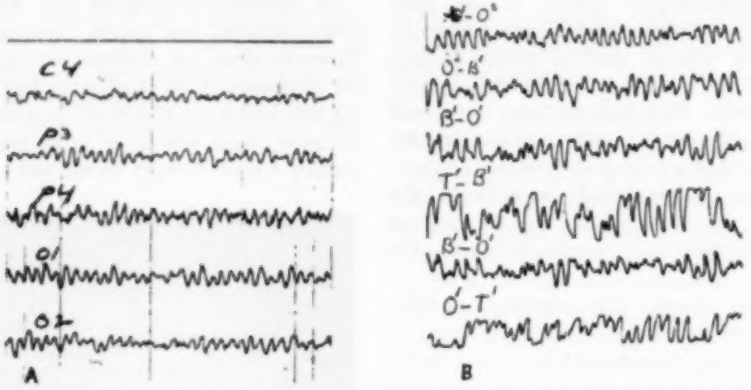

Fig. 3 (Berkley and Bussey). *Case 1.* (A) Normal E.E.G. using conventional leads. (B) When one electrode is placed in the nasopharynx all tracings using this electrode as one of two showed marked increase in amplitude and bizzare dysrhythmia which is compatible with cerebellar and occipital dysfunction.

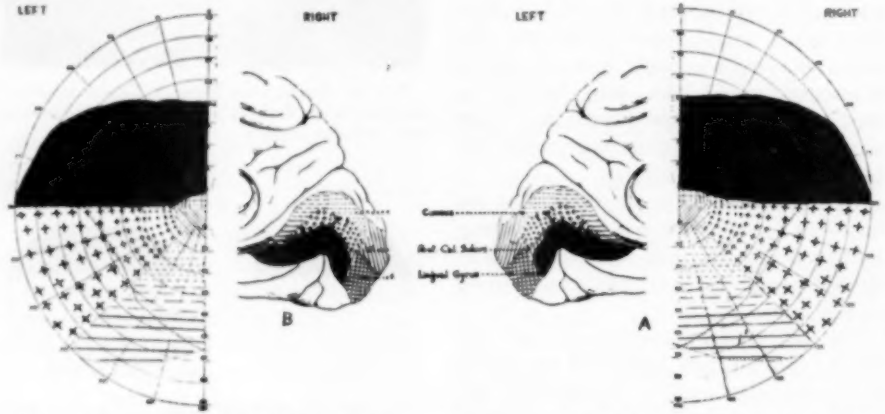

Fig. 4 (Berkley and Bussey). *Case 1.* Diagrammatic representation of the visual cortex lesion and the resultant visual defect projected onto the corresponding fields (black represents the affected components). (A) Left cortical lesion and the affected corresponding right upper quadrant field of each eye. (B) Right cortical lesion and the affected corresponding left upper quadrant field of each eye.

ing. It will be noted that, by using the appropriate components in Figure 4 for each eye, the visual fields in Figure 2B can be readily reproduced.

Superior altitudinal hemianopia in this case is of particular interest because of the probable mechanism by which it was produced. As previously indicated injuries to

The resultant superior horizontal hemianopia, by virtue of its position, produces a minimal loss of visual efficiency, causes a

relatively minor degree of complaint, and is not to an appreciable degree economically handicapping.

CASE 2

History. D. L. T., a 21-year-old seaman, was severely injured on October 19, 1944, by a shell explosion during landing operations against the enemy. The patient immediately became unconscious. Examination shortly thereafter revealed a small penetrating occipital skull injury, a deep laceration behind the right ear, multiple flesh wounds of the back, and a deep cut of the left elbow. The pupil of the right eye was widely dilated.

With returning consciousness, one week later, the patient was found to have a right hemiparesis, a left ulnar nerve paralysis, impaired hearing of the right ear, and a disturbing blurring of vision.

Roentgenographic studies showed a polar occipital skull defect containing depressed bone fragments and many small- and medium-sized opaque foreign bodies lodged within the occipital brain substance (fig. 5A). A larger oval-shaped metallic body lay in the anterior portion of the left frontal lobe. Small pieces of bone fragments and a piece of shrapnel were subsequently removed from the occipital wound and a long convalescence ensued.

On September 26, 1945, approximately 11 months following injury, the patient was transferred to the U. S. Naval Hospital, St. Albans, New York, for a left ulnar neurolysis, and further rehabilitation.

Reëxamination revealed an alert and coöperative patient who complained chiefly of annoying blurring of vision and a sensation of a bar being placed across his lower visual field. The scars caused by the previously described head injuries were well healed, but resultant right hemiparesis of the upper motor neuron type, a left flaccid ulnar paralysis, and defective hearing of the right ear remained.

Eye examination. Vision in the right eye was 20/20; the left eye, 16/20; binocular vision, 20/20. The left eye was not further correctible with lenses. The pupils were slightly dilated, but reacted readily to light and accommodation. The fundi were somewhat more red than is usually seen, and the upper halves of the disc margins were slightly hazy, but these findings were, perhaps, within normal limits.

Fig. 5A (Berkley and Bussey). *Case 2.* Roentgenogram of skull showing defect of skull at occiput, small metallic fragments in the occipital lobes, and a larger fragment in the left frontal lobe.

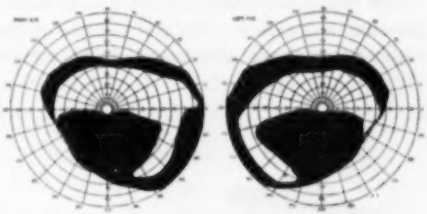

Fig. 5B (Berkley and Bussey). *Case 2.* Visual fields for 5/330 white, taken March 21, 1947.

Visual-field studies showed an incomplete but constant bilateral, inferior, altitudinal hemianopia (fig. 5B).

Encephalographic studies. A pneumoencephalogram showed a slight dilatation of the left ventricle. The lateral ventricles were well-demonstrated, and showed no evidence of displacement or deformity. The cerebral

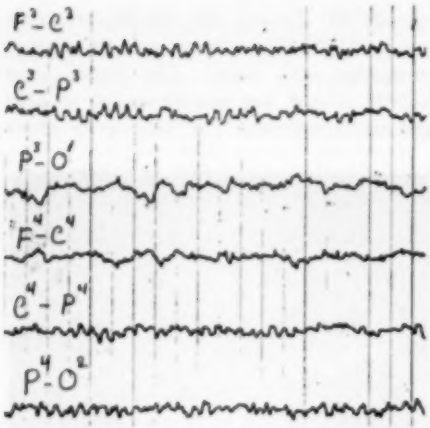

Fig. 6 (Berkley and Bussey). *Case 2.* Abnormal E.E.G., indicating occipital lobe dysfunction. Note irregular alpha waves with dysrhythmic depressed beta waves superimposed, especially in P^4–O^2.

sulci appeared normal, but very little air was present in the basal cisternas. Several small bone spicules projected into the posterior fossa from the site of the occipital bony defect.

The electro-encephalogram was abnormal, showing large slow irregular alpha waves with dysrhythmic depressed beta waves superimposed in an especially noteworthy manner in the occipital area represented by P^3–O^1 (fig. 6).

Course. During this patient's two-year stay in this hospital, his visual-field defect showed no change. He continued to complain of visual blurring and occasional complete visual blackouts, at which times he was seized with vertigo and vision faded out completely for a few minutes.

These spells may have been of a functional nature superimposed upon his partial cortical blindness, or they may have resulted from a transient spasm of the vessels supplying the visual cortex. The first explanation seems more likely.

Comments

As far as the pathologic changes in the visual pathway are concerned, the history, site of injury, field defect, roentgenographic studies, and electroencephalogram indicate a destructive bilateral lesion involving the upper lips of the calcarine fissures or the adjacent optic radiations. Figure 7 indicates the probable site of this lesion on the cortex bilaterally and the resultant bilateral visual-field defects. Allowing for natural field

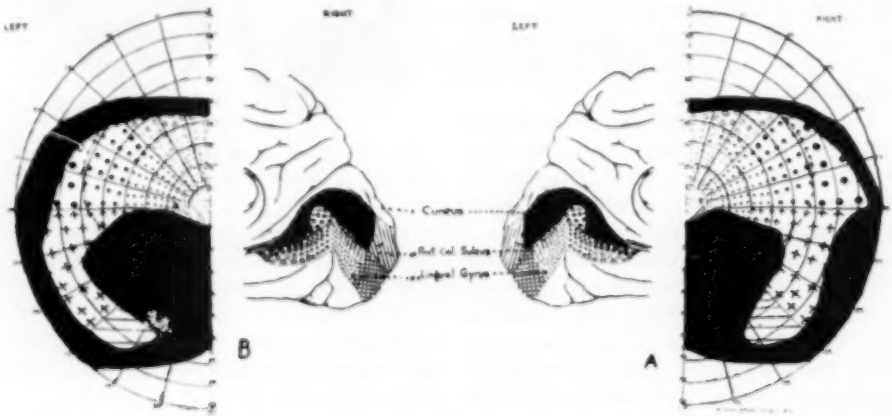

Fig. 7 (Berkley and Bussey). *Case 2.* Diagrammatic representation of the visual cortex lesion (black) and the resultant visual defect projected onto the corresponding (visual) field. (A) Left cortical lesion and the affected corresponding right lower visual field quadrant of each eye. (B) Right cortical lesion and the affected corresponding left lower visual field quadrant of each eye.

limitations on the nasal sides, the fields of the two eyes are seen to be practically identical.

It should be noted that, in contrast to superior altitudinal hemianopia, the inferior type causes bitter complaints and produces a severe loss of visual efficiency. Or stated otherwise: while the percentage loss of visual fields may be the same in the two types of defect, the percentage loss of visual efficiency is naturally very much greater in the inferior type, in which case the condition may be sufficiently severe to constitute a serious economic handicap and render the patient unfit for many types of occupation.

Sparing of the Macula

The phenomenon of sparing of the macula is noteworthily present in both cases, but strikingly demonstrated in Case 2 (fig. 8). This phenomenon, when actually present, is generally explained on the basis of: (1) Dual blood supply to the macular region of the visual cortex; (2) bilateral cortical representation of the macula; (3) the wide representation and distribution of the macular fibers in the visual cortex.

Of the three explanations, we place the greater emphasis upon the last, and consider that the sparing of the macula, when found, is to be attributed to an extensive macular representation in the calcarine area, part of which is left intact to supply the macular cones which are more compact and more sensitive than those in the peripheral retina.

Prosaa[6] has reviewed the literature on this subject and, in our opinion, has further discredited the idea of bilateral representation of the macula by his excellent report of five cases of hemianopia, without sparing of the macular vision, after occipital lobectomy for neoplasm. In one case there was macular sparing preoperatively, but it was lost after operation. Such reports would certainly seem to prove conclusively the absence of bilateral cortical macular representation.

Case 2 affords an opportunity to observe, or study, three types of interesting neurologic lesions in the same patient. The first type, the visual cortex lesion, has been discussed. The second presents an upper motor-neuron lesion which caused the right-sided hemiparesis.

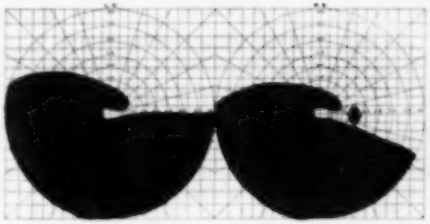

Fig. 8 (Berkley and Bussey). *Case 2.* Central visual fields plotted on tangent screen (2/1,000 mm. white). The phenomenon was sharp and constant.

This condition was most likely produced by the oval fragment, seen in the left frontal lobe, which passed through the internal capsule, with resultant injury to the motor tract, en route from its occipital point of entry to its final location. The paresis was of the spastic type with hyperactive deep reflexes, muscle weakness, and incoördination.

The third type of lesion was a left ulnar injury which produced a flaccid paralysis of the lower motor-neuron type with anesthesia, atrophy of the muscles involved, and hypoactive deep reflexes.

Summary

Altitudinal hemianopia should be considered as a wide sector defect rather than a true hemianopia. The condition is usually produced by bilateral visual cortex injury, often from missiles projected transversely through the occipital lobes.

The inferior visual half-field defects are most often seen since those injuries which produce the superior half-field defect usually result fatally.

The inferior field defect results in much greater inconvenience and loss of visual efficiency than does the superior type. A case report of each type is presented.

U. S. Naval Mission, A.P.O. 676.

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THE LYSOZYME CONTENT OF TEARS*

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Lysozyme is an enzyme that catalyzes the depolymerization of highly polymerized mucopolysaccharides. This means that it is a mucolytic enzyme which breaks complicated mucoids into simpler forms, liberating a reducing sugar believed to be an hexosamine.

There are many sources of lysozyme. They range from turnips and egg white to saliva, white cells, and tears. The enzyme is present in many animals but it is not always found in similar tissues in different species. There is some evidence to suggest that lysozyme from various sources may differ chemically.[1]

The uses of lysozyme are rather restricted. It is said to be used to preserve caviar and to protect the throats of singers in Russia. In the abstracts from Russian ophthalmic literature there are some reports of its successful use in the treatment of conjunctivitis and of corneal ulcers.[2, 3]

Since its discovery by Fleming, in 1922, lysozyme usually has been studied from the point of view of its bacteriolytic properties. Fleming found that, even in high dilutions, the enzyme was active against a micrococcus which he had isolated and which he named Micrococcus lysodeikticus.[4] It is now believed that this lysis which can occur in living or in dead bacteria takes place by means of hydrolysis of mucoid substances found within the bacterial membrane.[5]

After Fleming's work, lysozyme was found to be active against some other pathogenic and nonpathogenic bacteria, notably Sarcina lutea. However, the concentrations of lysozyme required to inhibit pathogenic bacteria are higher than those needed for inhibiting Sarcina or Micrococcus lysodeikticus. Ridley has stated that, while the normal lysozyme content of tears may be effective against some pathogenic bacteria, the lysozyme concentration need be decreased only very slightly to be totally ineffective against all pathogens.[6] It generally has been held that the lysozyme in tears acts as a protective agent against bacterial infection.

The knowledge of the action of another mucolytic enzyme, hyaluronidase, upon hyaluronic acid has led to a consideration of the possible functions of lysozyme upon mucoids or mucopolysaccharides found in animal and human tissues. This possibility has been confirmed recently by the findings by Meyer and his colleagues.[7, 8] They report high lysozyme titers in gastric secretions of patients with peptic ulcer and in the stools of those with ulcerative colitis.

In the past all lysozyme determinations were made by serial titrations of lysozyme-containing substances against susceptible bacteria—usually some strain of Micrococcus lysodeikticus or Sarcina lutea. This method is slow and laborious and it is not

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exact. It is believed to involve actions by other bacteriolytic enzymes as well as by lysozyme.[9]

In 1946, Meyer and Hahnel published a description of a viscosimetric method for the estimation of lysozyme.[10] This method has several advantages. It is speedy, the results are accurate, and the test, based as it is on a single chemical reaction, is specific. The mechanism of this method is as follows:

As was stated previously, lysozyme hydrolyzes a mucoid substance found in the walls of certain bacteria. Through earlier work by Meyer and his associates, a highly polymerized form of this mucoid substrate has been isolated.[9] This has a high viscosity which decreases as lysozyme acts upon the substrate. The fall in viscosity is in direct relation to the amount of lysozyme present. Therefore, if a constant amount of substrate is used, the amount of lysozyme present in a given sample may be determined. This quantity of lysozyme is expressed in units per cubic centimeter. By definition, one unit is the amount of enzyme required to reach a half viscosity in 10 minutes.

In the present determination of the lysozyme content of tears, Meyer and Hahnel's viscosimetric method was used. The establishment of the normal lysozyme level in tears and the presence of a variation in a few pathologic conditions were sought. The tears were collected by suction in a small tube, shaped somewhat like an undine. Since one often was dealing with cases characterized by a lack of tears or by lack of corneal sensitivity, it was necessary to use a strong lacrimator. For this purpose benzyl chloride was employed.

In the literature there are several papers which present an extensive analysis of the lysozyme titer of tears. The first is the work of Cavka and Prica published in 1929.[11] In 1930, Hallauer reported his results.[12] Other authors, notably James[13] and Thompson and Gallardo,[14] have published their analysis.[15]

Because the unitage and the substrate vary, the work presented here cannot be compared directly with that in which the bacteriologic method of assay was used. However, certain trends in the lysozyme concentration of tears may be significant.

TABLE 1

LYSOZYME CONTENT IN NORMAL TEARS

Method	Viscosimetric
Range (35 tests)	800–2500 U/cc
Average	1438 U/cc
Average (male—4 cases)	1534 U/cc
Average (female—12 cases)	1430 U/cc

LYSOZYME CONTENT OF TEARS IN NORMAL EYES

The lysozyme content of tears was determined in 35 tests on 17 normal individuals (table 1). The titer of lysozyme was found to vary widely, ranging from 800 to 2,500 units of lysozyme per cubic centimeter. The average lysozyme concentration in normal tears was 1,438 units per cubic centimeter. There was no significant relationship to sex or age. A similar wide variation has been found by workers who used the biologic method of assay.[11–14]

Repeated tests were made on seven individuals (table 2). The interval between tests varied from one week to one year. The variation in difference in lysozyme content ranged from 2 to 101 percent. This is in accord with the findings of Thompson and Gallardo[14] who reported more or less con-

TABLE 2

VARIATION IN LYSOZYME CONTENT WITH TIME

Case	Range (units/cc)	Percent Difference	Average (units/cc)
R.	1500–2000	33	1802
S.	1325–1540	16	1433
X.	1540–2500	62	2020
K.	851–1538	80	1135
B.	1429–1480	2	1455
M.	904–1820	101	1275
H.	1430–2350	64	1743

TABLE 3

VARIATIONS IN LYSOZYME BETWEEN EYES

Case	O.D. (units/cc)	O.S. (units/cc)	Percent Difference
X.	2500	1540	62
H.	1430	1430	0
F.	1425	1810	26
A H.	1175	1025	12
R.	2000	2000	0
K.	1330	1583	19
M.B.	1429	1480	2
	1460	1460	0

stant values during short periods but found extreme variations over longer intervals.

Tears from each eye were analyzed separately on the same day in seven normal individuals (table 3). In five there was relatively little difference in the lysozyme content of each eye. In two there was a large variation, the lower lysozyme concentration being in the second eye from which tears were collected. It required considerable stimulation to obtain tears in these individuals. The possibility of a psychic factor has been suggested in these cases since it has been demonstrated that the lysozyme content of the colon in patients with ulcerative colitis may suddenly increase if painful psychic stimuli are used.[16]

LYSOZYME CONTENT OF TEARS IN PATHOLOGIC CONDITIONS

ACUTE CONJUNCTIVITIS

Eight cases of acute conjunctivitis, six of them unilateral, were tested (table 4). In these cases there seemed to be a tendency to a low or a low-normal lysozyme concentration in the tears. However, the percent difference between the affected and the nonaffected eye often was no greater than in normals. Both bacterial and chemical (flash and lime burns) conjunctivitis showed the same tendency to decreased lysozyme concentration. It is my impression that there was more epiphora in those cases with lower lysozyme contents. This tendency to a lower than average lysozyme concentration in acute conjunctivitis agrees with earlier reports.[11, 14]

CORNEAL ULCERS

A few corneal lesions were studied (table 5). The number of cases is too small to be significant. In corneal ulcers, however, the

TABLE 4

ACUTE CONJUNCTIVITIS

	Case	Lysozyme Content (units/cc)		Percent Difference
		O.D.	O.S.	
Bilateral Conjunctivitis	G.B.M.H.	1025	910	13
	R.M.	712	712	0
Unilateral Conjunctivitis	E.C. (acute bacterial)	1540*	1665	7
	P.G. (chemical)	888*	1110	12
	T.Y. (acute bacterial)		1050*	
	R.W. (chemical)	712	333*	105
	E.E. (acute bacterial)	1250	740*	68

* Affected eye.

TABLE 5

LYSOZYME CONTENT OF TEARS IN CORNEAL LESIONS

Disease	Case	Lysozyme Content (units/cc)
Corneal ulcer	S.P.	500
	S.O.	300 (1250—healing)
	R.R.	632 (1815—healed)
Rosacea keratitis	B.M.	1550 (inactive)
	A.G.	1160 (inactive)
	R.J.	780 (active)
Phlyctenular keratitis	B.S.	1406 (active)
Limbal vernal	B.H.	1212 (active)
Epidemic keratoconjunctivitis	M.K.	303 (O.D.) 250 (O.S.) (marked epiphora)
		840 (O.D.) 840 (O.S.) (improving)
	V.S.	1000 (little epiphora)
Corneal dystrophy (Fuchs)	E.B.	700–1000
	M.C.	888
	M.S.	740– 770
	A.S.	668
Lipoid degeneration	M.W.	1000
Unknown	G.A.	1430
	A.T.	1250
		950
Keratoconjunctivitis sicca	E.H.	250– 375 (Sjøgren's syndrome)
	W.	735
	A.H.	379– 700 (Sjøgrea's syndrome)
	G.	1222
	V.V.	2000 (Low Schirmer test only)

lysozyme concentration of the affected eye was strikingly lower than in the nonaffected eye. It is interesting to observe that in the single case (R. R.) in which further tests were made, the lysozyme content of the tears rose to normal levels after the ulcer healed.

The lowered lysozyme content of tears in the presence of corneal ulcers has been demonstrated by others.[11, 12] It has yet to be shown if this is the cause of the ulcer or if it is a result of the increased tearing which occurs in the presence of an ulcer.

CORNEAL DYSTROPHY

In the six cases of corneal dystrophy studied, the lysozyme content of the tears was either borderline or below normal levels (table 5). Cavka and Prica have reported a case of "degenerated cornea" in which the lysozyme concentration in the tears was well below the normal range.[11]

KERATOCONJUNCTIVITIS SICCA

Five patients with keratoconjunctivitis sicca and one (V. V.) with a low Schirmer test but without evidence of a pathologic condition of the cornea were studied (table 5). In those patients who had definite keratoconjunctivitis sicca the lysozyme concentration of the tears tended to be low and to vary with the severity of the disease. This may be due to the progressive pathologic processes in the lacrimal glands—that is, chronic inflammatory and degenerative changes.

In a patient (W.) with only moderate signs and symptoms of keratoconjunctivitis sicca an injection of histamine resulted in an increase in the lysozyme content of the

TABLE 6

IRIDOCYCLITIS

Case	Lysozyme Content (units/cc) O.D.	O.S.
I.C.	1000	1535
E.Z. (x)	1110*	2220
H.L.P. (x)	2220	1000*
R.R.	870*	910*
H.E. (x)	680	370*

(x) Marked tearing.
* Affected eye.

tears to 1,456 units per cubic centimeter, almost double the amount before using histamine. However there was no demonstable increase in tearing.*

E. H., who had a fully developed case of Sjøgren's syndrome, showed no increase in the lysozyme content after histamine injection. Treatment with lysozyme was not successful. Despite marked improvement after closing the puncta, there was no increase in the lysozyme concentration of the tears.

IRIDOCYCLITIS

Five cases of iridocyclitis were studied (table 6). In the literature a low lysozyme content in tears is reported in cases of iridocyclitis. The results presented here suggest that the lysozyme concentration of the tears is low in those cases in which epiphora is a symptom.[11]

CONCLUSION AND SUMMARY

The number of cases presented is far too small to permit final conclusions. Much more extensive studies are required. In general the findings presented in this paper show the same trends and tendencies as those of authors who used the bacteriologic methods of assay.

When the viscosimetric method of lysozyme determination is used, the range of lysozyme in normal tears is generally between 1,000 and 2,000 units per cubic centimeters of tears. There is no demonstrable variation with age or sex, but there seems to be a daily variation in the concentration of lysozyme. The effect of emotional and autonomic nervous-system stimuli should be investigated.

The lysozyme content of the tears usually is low in pathologic conditions associated with excessive tearing. These are acute conjunctivitis, corneal ulcers, and iridocyclitis when epiphora is a prominent feature.

The lysozyme content of tears is lowered if decreased tearing is associated with destruction of lacrimal tissue. Such a state is found in keratoconjunctivitis sicca and in chronic or acute dacryoadenitis.

In cases of corneal dystrophy the lysozyme content of the tears was low.

None of the pathologic conditions studied showed a high lysozyme concentration in the tears. In this respect, it might be of interest to study the concentration in some systemic diseases, especially early hyperthyroidism where epiphora is a symptom, and in the tears produced by stellate ganglion block.

635 West 165th Street (32).

* Tearing was determined by the Schirmer test. This test is not sufficiently accurate to rule out a small increase in tears.

I wish to express my thanks to Dr. Karl Meyer and to Miss Anita Steinberg for their kind and valuable assistance.

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CLINICAL MANAGEMENT OF OCULAR SYPHILIS*

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Syphilis has been recognized for many years as a major cause of eye disability and blindness. In more recent times, the incidence of syphilis of the eye has diminished to such an extent that patients with the disease are viewed with considerable curiosity. This is true in New York and other areas of the United States, according to Holle[1] of the United States Public Health Service. In spite of its rareness, ocular syphilis still exists and warrants the same respect it received when it was a major cause of blindness. The purpose of this paper is to offer comment on the present management of ocular syphilis in clinics and hospitals, and to make suggestions for improvement.

A similar report on ocular syphilis was made by Berens and Goldberg[2] before the American Medical Association in 1937. The principal objectives of the study in five New York City hospitals in 1937 were the following: (1) To evaluate the method in which clinic records were kept at various eye clinics in New York City; (2) to analyze the material recorded in the clinic records; (3) to determine whether serologic tests for syphilis were ordered routinely in eye diseases; (4) to estimate the percentage of the various eye diseases which might be caused by syphilis; (5) to determine courses of treatment employed for syphilitic patients and the end results of such treatment; (6) to recommend improvements in the maintenance of records and the procedures to be followed in the handling of patients having syphilis of the eye.

Of the total of 100,000 case records studied in 1937, 5,969 or about six percent presented diagnoses which were classified by the Berens and Goldberg committee as possibly having syphilis as an etiologic factor. Of these only 2,237 had been given serologic tests for syphilis, and 444 or 19.9 percent had positive reactions. Serologic tests for syphilis, even in cases in which the eye disease listed was most likely to be etiologically related to syphilis, were not made as a mat-

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* Presented before the Section of Ophthalmology, New York Academy of Medicine, February, 1949. The data herein presented were prepared with the coöperation of the Social Hygiene Committee, New York Tuberculosis and Health Association.

ter of routine in any of the five institutions studied.

The report showed that inadequacy of records, of antisyphilitic treatment, of follow-up, and of social service activity was quite pronounced. Even when treatment was instituted, progress notes often failed to indicate the results of antisyphilitic treatment as they concerned the eye or from the serologic viewpoint.

Since this earlier study was completed, much of importance has happened in the field of syphilis. The advent of penicillin and other therapeutic measures and the highly successful results that have been achieved with them in the treatment of this disease made it desirable to undertake another study of ocular syphilis from a slightly different approach. The coöperation of the administrators of three hospitals in New York City, in which eye patients are treated, was obtained. Two of these hospitals participated in the 1937 study. This time (1948), instead of trying to ferret out cases of ocular syphilis, only the charts of known cases of ocular syphilis were studied. In view of the widespread use of penicillin during the past four years, it was decided to attempt to evaluate this new drug in the treatment of ocular syphilis.

In making this study, the form used for the 1937 survey was employed. This form covered personal history, family history, clinical findings, laboratory findings, syphilitic manifestations in the eye, diagnosis on admission and discharge, treatment, follow-up, disposition, and the result on the eye condition of the syphilitic therapy.

In the present study, the charts of 467 patients were analyzed. Table 1 reports the syphilitic manifestations present in the eye in these cases.

TABLE 1

SYPHILITIC MANIFESTATIONS IN THE EYE

Diagnosis	Hosp. A	Hosp. B	Hosp. C	Totals
Iritis	2	26	15	43
Iridocyclitis	—	12	2	14
Retinitis	—	9	1	10
Chorioretinitis	—	10	8	18
Choroiditis	—	3	2	5
Optic atrophy	10	52	16	78
Ophthalmoplegia	1	15	3	19
Uveitis	—	7	—	7
Interstitial keratitis	4	55	16	75
Keratitis	1	23	4	28
Kerato-iritis	—	10	—	10
Argyll-Robertson pupil	10	1	1	12
Dacryocystitis	—	3	1	4
Optic neuritis	2	6	—	8
Retrobulbar neuritis	—	1	3	4
Episcleritis	—	5	—	5
Postsynechia	—	4	—	4
Other syphilitic eye manifestations	6	5	11	22
Other nonsyphilitic eye manifestations	21	—	80	101
Totals	57	247	163	467

Table 2 indicates the comparative infrequency in the use of penicillin. In Hospital A, 57 patients' charts were studied; only five received penicillin; in Hospital B, of 247 patients, 16 were given penicillin; and in Hospital C, of 163 patients, five received penicillin and 27, penicillin and chemicals. The total amount of penicillin administered varied from 5,000 units in one case to 12,000,000 in another.

The comparative infrequency with which penicillin was used may be due to several factors. There is apparently considerable doubt as to the efficacy of penicillin in the

treatment of ocular syphilis. Only a few published reports have appeared. Klauder[3] reports that the absence of any striking result in the final visual acuity of penicillin-treated patients is consistent with clinical observation that penicillin does not uniformly exact an immediate favorable effect on active interstitial keratitis. Such effect is not comparable to the effect on cutaneous lesions of early syphilis, or iritis of late secondary syphilis. An occasional severe case seems to be benefited. On the other hand, other severe cases of the disease are definitely not improved by penicillin, nor indeed by any other method of treatment. Klauder's observations were confirmed by London and Noojin[4] in a preliminary report on nine patients with congenital syphilitic interstitial keratitis.

In the current study, on which this report is based, an effort was made to determine the completeness of the individual charts, especially in the matters of (a) personal history, (b) family history, (c) contacts, (d) laboratory tests, (e) follow-up, (f) disposition, and (g) results of therapy. Other items on the charts were likewise analyzed and tabulated whenever deemed desirable.

The conclusions drawn were as follows:

Personal history

Hospital A. Personal history was very brief. When patients reported having had treatment elsewhere, there was no record of an attempt to contact other institutions to determine the diagnosis made or the kind and extent of treatment given.

Hospital B. There was seldom any notation as to history of previous infection or treatment. When notes were made, they were rather sketchy and did not appear to have been verified by correspondence with other medical agencies.

TABLE 2

Treatment administered

Treatment	Hosp. A	Hosp. B	Hosp. C	Totals
Penicillin only	2	10	5	17
Penicillin and chemicals	2	6	27	35
Penicillin, chemicals, and fever therapy	1	—	—	1
Penicillin advised, but no record of administration	—	1	—	1
No penicillin	52	90	131	273
No treatment of any kind (referred elsewhere)	—	140	—	140
Totals	57	247	163	467

Hospital C. Personal history was infrequently noted, and then only briefly and incompletely.

Family history

Hospital A. It was noted that for 39 out of a total of 163 patients, some data on family history were recorded; the information usually related to living children and their physical condition. The balance of the charts gave no family history.

Hospital B. While almost all social-service records contained information as to members of the patient's family, there were but few about whom the results of blood tests were recorded.

Hospital C. Charts had family history but infrequently reported, and then only briefly and incompletely.

Contact-tracing

Hospital A. Reports of familial and other contacts were not recorded.

Hospital B. Records were likewise deficient in this respect.

Hospital C. Contact history was not a part of the chart, but the notes of the social-

service worker interviewing the patients sometimes had occasional reference to contacts.

Laboratory reports

Hospital A. Out of a total of 163 patients, spinal-fluid examinations were made on 73, with 17 reported as being positive and one doubtful.

Hospital B. Very few spinal-fluid examinations were performed in spite of the fact that there were many patients under treatment for several years. Of 247 patients, only 17 were examined, eight of them being reported as positive.

Hospital C. When it was found desirable to do spinal-fluid examinations, these were frequently repeated throughout the patient's course of treatment. Of 262 patients, 57 were given spinal-fluid examinations, and, of these, 21 were positive, nine negative after treatment, and one doubtful.

Follow-up

Hospital A. When patients were delinquent, there was little evidence of any social-service follow-up on the record, outside of the sending of letters.

Hospital B. Follow-up for delinquent patients consisted of no more than two letters and a post card, and if no response was made to these, the case was closed.

Hospital C. No attempts were made at home visiting for delinquent patients; if there was no response to cards or letters, the patient was reported to the Department of Health, with a request for a home visit, and, if they reported no response, the case was closed.

Disposition

Hospital A. When patients were transferred or referred elsewhere, there was no record on the chart of the treatment history having been transferred, nor of any attempt to check to see that the patients really reported to another institution for treatment.

Hospital B. On referrals to other agencies, the social-service worker usually checked to verify that the patient actually reported there, but, after penicillin treatment, this was not done as a rule.

Hospital C. Patients were often not referred to the eye clinic for examination, but the findings were noted in the medical or neurologic clinic.

Results of treatment on eye condition

One of the important aspects of treating syphilitic patients, particularly when newer therapies are involved, is to know the results of the treatment on the eye condition.

Hospital A. The results of such treatment on the eye condition were rarely given.

Hospital B. Notations as to the results of treatment on the eye condition likewise appeared infrequently.

Hospital C. There seemed to be little if any follow-up or comment on the results of the treatment on the eye condition.

In view of the fact that a fair number of patients in these three institutions received treatment with penicillin, it would have been most helpful, in appraising the results of such treatment, if careful notes had been made before discharge.

Discussion

It is evident that the inadequacy of chart entries and the shortcomings in certain services to the patients in these three institutions make it impossible to draw valid conclusions and to set up recommendations relating to several aspects of ocular syphilis. Full knowledge of the institutions concerned leads one to definite stipulations as to the need for additional financial resources with which to provide additional medical, laboratory, social service, nursing, and clerical personnel. Until it becomes possible to staff our institutions fully, it will be futile, with but few exceptions, to expect a completely

TABLE 3

SUGGESTED SIMPLIFIED CHART FORM

I. Name _____ Address _____

II. Case No. _____ Age _____ W( ). N( ). S( ). M( ). W( ). D( ).

III. Hosp.Pt. ___ Clinic Pt. ___ Both ___ Date Adm. _____ Date Disch. _____

IV. Diagnosis on Admission: _____

V. Personal History:
Syphilis: Genital Lesions _____ Skin Lesions _____ Ulcers _____
Treatment: Where _____

VI. Family History:
(a) Syphilis in Father _____ Mother _____ Patient's Children _____
(b) History of Locomotor Ataxia _____ General Paralysis _____
(c) Cause of Death of Father _____ Mother _____
(d) Brothers _____ Sisters _____
(e) Children _____ Stillbirths _____
(f) Hospitalisation _____

VII. Clinic Findings:
Tabes Dorsalis (locomotor ataxia) ( ); Dementia Paralytica (general paralysis of insane( ); Taboparesis( ); Meningo-vascular syphilis( ); Congenital syphilis( ); Gumma( ); Other -

VIII. Laboratory:
Serologic Tests _____ Neg.( ); Doubt.( ); Pos.( )
Spinal fluid-Colloidal Gold _____ Neg.( ); Doubt.( ); Pos.( )
Darkfield: Neg. ( ); Pos.( )

IX. Syphilitic Manifestations in Eye:
Any Ophthalmoplegia( ); Interstitial Keratitis( ); Argyll Robertson Pupil( ); Iritis ( ); Iridocyclitis( ); Choroiditis( ); Retinitis( ); Optic Neuritis( ); Optic Atrophy( )
Other:

X. Diagnosis on Discharge: _____

XI. Treatment:
Arsenicals (kind and amount) _____
Bismuth (kind and amount) _____
Fever (kind and amount) _____
Penicillin (kind and amount) _____

XII. Follow-up:
(a) for eye: _____
(b) for syphilis: _____

XIII. Disposition of Case:
(a) Treated in hospital-clinic( ) Department _____
(b) Referred to: _____

XIV. Result of Syphilis Treatment on Eye Condition: (a) Improved( ); (b) Cured( ); (c) No change( ); (d) Regressed( ).

XV. Summary: _____

integrated service, especially for clinic patients.

To date, the evidence for the therapeutic usefulness of penicillin in certain cases of ocular syphilis is discouraging. However, more research is needed before the use of

penicillin in the treatment of these patients can be either accepted or condemned.

The question as to the best procedures to be followed leads to recommendation of a standardized and simplified record form to facilitate the checking of histories, findings, therapy, recommendations, and so forth. Whether the form shown in Table 3 would meet the needs of physicians in many institutions is open to some question. However, if the patient is to be helped, some plan should be developed to standardize the current multiplicity of forms, to provide clinic reorganization, and to improve assignment of available personnel.

Conclusions

The conclusions to be drawn from this survey are:

1. Ocular syphilis, although not as prevalent as formerly, is, when present, just as vicious as ever.

2. Syphilis of the eye is not being treated in accordance with newer developments in therapy in representative hospitals and clinics.

3. Records and follow-up studies on syphilitic patients are woefully inadequate.

4. Suggestions for improvement of service and a simplified chart form are offered.

17 East 72nd Street (21).

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Ophthalmic Miniature

A soldier of the mind, the investigator defends his native land with the microscope, the balance, the retort, or the telescope. As a result of this, far from accepting the progress made in other countries with interest and gratitude, he receives it grudgingly, as if it brought him insufferable humiliation, unless of course, the invention is so great that to ignore it would be a sin against patriotism.

Santiago Ramon y Cajal.

EXPERIMENT IN GLAUCOMA CASE FINDING*

A PRELIMINARY REPORT

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This preliminary report deals with an experiment in glaucoma case finding which originated with the Philadelphia Committee for Prevention of Blindness‡ and to our knowledge is the first of its kind to be undertaken. It is based on a mass screening, by ophthalmologists, of 3,923 persons.

Since prevention of blindness is generally recognized as a ramification of public health, the committee believes that early discovery of blinding conditions and prompt, adequate, and uninterrupted treatment for them parallels the control of such diseases as cancer, tuberculosis, heart disease, and others.

To quote from "A community organization for mass chest X-ray surveys."[1]

"It is universally recognized that tuberculosis is almost symptomless at its onset and may go undetected for a long time until it has reached an advanced stage, not infrequently until after the disease has been communicated to others. Since the patient will not seek the physician during the early stages of the disease, because he is not aware that anything is wrong, the physician must find ways and means to seek him."

The term "glaucoma" might well be substituted for tuberculosis except for the implication of communication to others.

Motivation for mass eye examinations to locate early glaucoma actually began when the Pennsylvania legislature enacted a blind-pension law. Eligibility for the assistance it provided was established by visual acuity, state residency, financial status, and other minor factors. To determine visual efficiency, applicants were required to be examined by qualified ophthalmologists and according to a standard procedure recommended by leaders in ophthalmology.

From this source reliable statistics on the causes of blindness in Pennsylvania became available. The first report was published by Cowan and English.[2] It was under the guidance of Dr. Cowan, supervising ophthalmologist for the state, that the rules and regulations for administering the medical sections of the law were established. The report revealed that glaucoma had caused 12.9 percent of the blindness in Pennsylvania; chronic simple glaucoma accounted for 11.5 percent; acute glaucoma, 1.4 percent. The rate in Philadelphia county was considerably higher—18.5 percent. In spite of knowledge of the prevalence of glaucoma, there was no organized follow-up of patients in eye clinics in Philadelphia until 1940.

Twelve years earlier, the late Dr. George S. Derby[3] had sufficient foresight to realize that glaucoma patients cannot be herded into the average clinic and treated in the same fashion as the average clinic patient. It was through his efforts and with the assistance of the National Society for the Prevention of Blindness that a glaucoma clinic combined with a medical social service for follow-up was started at the Massachusetts Eye and Ear Infirmary.

Speaking before the Section on Ophthalmology at the 82nd annual session of the American Medical Association, Dr. Derby said: "I believe I do not exaggerate in saying that it has increased the efficiency of the service that we give our patients by 50 percent at the very least."

* Presented at the annual conference of the National Society for the Prevention of Blindness, New York, March, 1949.

† Director, Philadelphia Committee for Prevention of Blindness.

‡ The Philadelphia Committee for Prevention of Blindness is an educational agency which functions through a medical advisory council to create in the community an awareness to the causes of blindness and measures for their control.

Dr. Derby's experience, together with the knowledge of Pennsylvania's high rate of blindness from glaucoma, impelled the Philadelphia Committee for Prevention of Blindness to seek the coöperation of Wills Hospital in developing a similar combined clinic and medical social service for Philadelphia.

A study of hospital records for five years revealed that few glaucoma patients—only two in fact—were reporting regularly to the clinic. One or two visits were recorded, then a lapse, and then the entry "referred for blind pension" was noted. Nearly all patients had suffered great visual damage before their first visit—many gave a history of having shopped around from clinic to clinic. Findings indicated a great need for the closer and permanent relationship between patients and physicians which develops only through education and constant follow-up.

Supported by facts, and after detailed discussion with clinic chiefs and the superintendent of Wills Hospital, the committee initiated and financed for five years an intensive glaucoma service in four eye clinics. At the end of the first year the volume of glaucoma patients had increased from 156 to 344 and all except two were regular clinic attendants. None had been referred for blind pension. After two years, Wills Hospital employed an additional worker which extended glaucoma service to all nine eye clinics in the hospital.

In the meantime the committee was carrying on the work in two other hospitals—600 active patients were registered. It may have been coincidental, but in those two years the rate of blindness from glaucoma among those who applied for blind assistance in Philadelphia decreased from 18.5 percent to 17.2 percent.

A month-to-month study of ophthalmic records for 1948 reveals a rate of 12.4 percent—a decrease which we feel we can say is no longer coincidental. Rather it is the direct result of uninterrupted treatment due to uninterrupted awareness of the patient to his condition and to the importance of constant coöperation.*

Despite the increase in volume of patients and clinic attendance, there was little evidence that the early glaucoma patient was being reached. Advanced and moderately advanced glaucoma with damaged vision was common to all.

Five years of extensive clinic and case work experience posed the great problem of how to find glaucoma earlier so that adequate supervision and treatment might begin while vision was good.

There was no pattern for case finding except proved methods familiar in other areas of public health; namely, examination of many to find the few early or potential sufferers.

The Philadelphia Committee for Prevention of Blindness studied a number of such experiments and from them finally evolved one believed to be suitable for mass eye examinations to locate symptoms of early glaucoma. It was sufficiently flexible for use in any type of industry housing a large personnel. It embraced: (1) Selection of the plant; (2) presentation of the project to the president or an official designated by him; (3) an educational program to acquaint employees with the service offered jointly by the plant and the Philadelphia Committee for Prevention of Blindness; (4) opportunity for those aged 40 years and older to register for the eye examination.

The examining unit

The examining unit consisted of a qualified ophthalmologist, a secretary to take his dictation and otherwise assist him, and a technician to measure the visual acuity and to take a simple history.

The eye examination

This ophthalmic examination was used as a simple screening experiment to test the

* Ophthalmic reports, Philadelphia Department of Public Assistance.

possibility of uncovering early glaucoma without exhaustive diagnostic procedures. It consisted of:

1. Visual acuity measurements, with and without correction.

2. External examination. Ocular movements, size of cornea, condition of anterior chamber, pupillary reaction, condition of iris.

3. Fundus examination. Critical observation with particular attention to cupping and its character.

4. Measurement of intraocular pressure by tonometer (Schiøtz).

The experiment was designed to reflect a cross section of the working population. No particular groups in either labor or industry were considered.

A large department store was selected as a suitable place to try out the experiment. There, as in other such stores, were middle-aged men and women. Many suffered from systemic hypertension, some were poorly nourished—not so much from actual lack of food as for properly cooked, well-balanced meals—few were economically secure.

It may be significant that, at the time, many had sons in active service and their emotional tension was at high pitch. This was a group, it was believed, which might yield early glaucoma, if state of mind can be regarded as a factor in producing increased intraocular pressure.

Several weeks before examinations were undertaken a simple story on glaucoma was prepared for the store's official publication. Two talks were given over the loud speaker which reached all employees before they went on duty. Registration cards were distributed to floor supervisors who urged those of middle age to take advantage of the free eye examinations which would be done in the store's finely equipped medical department. Employees were notified that permission from the management was freely given for the time, not only for the examinations but for any treatment which the doctor might recommend. Regardless of findings, their jobs would not be jeopardized. We examined 256 individuals.

Each person received at his home address a letter thanking him for his coöperation and advising him that his eyes were in good condition or, if findings indicated, giving him an appointment to return for a recheck and interpretation of the doctor's recommendations.

This extra service was designed to overcome the fear of labor representatives and employees that reports would be filed in the plant and thereby give cause for a change in job, pay, or even dismissal. The committee feels well repaid in the good will and coöperation received by way of the personal letters.

All persons with intraocular pressure of 25 mm. Hg (Schiøtz) or more were rechecked twice. If these additional measurements were above 25 mm. Hg, or if the fundi showed suspicious findings, the employee was then referred to either an ophthalmologist or, when financial circumstances prevented such aid, to an eye clinic for further diagnostic attention.

Findings on this initial group are:

Number examined, 256: 49 men, 207 women.

Number with tension of 25 mm. Hg (Schiøtz) or higher, 28.

Glaucoma diagnosed, six (2.3 percent); preglaucoma, two; recommended for continued observation, three; refused further diagnostic study, one; glaucoma ruled out, 15; secondary glaucoma* following an injury, one.

None of these six persons knew he had glaucoma. According to the best information we could obtain they had been refracted by optometrists, usually in the store's optical department.

No attempt has been made in this report to classify other ocular and systemic conditions which were brought to light. It is sufficient to state that all were interpreted

* Not included among diagnosed cases of Glaucoma.

and individuals were referred for treatment in accordance with accepted ethical procedure.

In the light of findings among this small group and in view of the expressed appreciation of employees and management, the committee was stimulated to offer its screening service to other stores and plants. Eventually all department stores and one large specialty shop accepted the offer and 1,906 persons in that area of employment were examined.

In order to sample other occupational fields, screening was extended to six industrial plants and two large insurance companies where 2,017 persons were examined.

Overall findings to date are:

	Male	*Female*	*Total*
Stores	690	1,216	1,906
Plants	1,063	446	1,509
Insurance companies	367	141	508
	2,120	1,803	3,923

Ocular tension 25 mm. Hg and above	352	
Ocular tension rechecked	293	
Referred for diagnostic study	117	
Glaucoma diagnosed	65	(1.65%)
Under observation	24*	

Discussion

Consideration of these findings from a strictly medical point of view brings little to light that has not been written. The subject of diagnosis of early glaucoma has been discussed many times and especially in such excellent papers as those by Posner and Schlossman,[4] Kronfeld and McGarry,[5] and Reese.[6]

Posner and Schlossman's paper emphasizes the fact that the patients studied had been followed carefully over a long period of years. The intraocular pressures were slightly abnormal or even normal. After 10 or 15 years, or more, however, these patients suddenly presented typical glaucoma findings. Their records offer further proof that extremely careful observation is necessary over a prolonged period of time before glaucoma can actually be diagnosed. Here is proof of the need for tenacious watchfulness so that a condition, which might eventually have a tragic outcome, will not be overlooked.

Although these forerunning conditions may be known as mild glaucoma, prodromal glaucoma, early glaucoma, incipient glaucoma, and by other names, it is important to have proper investigation and continuous observation during this uncertain stage in order to prevent great loss of vision.

Kronfeld and McGarry, in their excellent work based on a five-year follow-up of a large number of cases, have shown that the majority of eyes treated properly in the early stage of glaucoma can be maintained with normal tension and slight or no loss of field; whereas, it is well known, little can be done to arrest glaucoma once it has progressed into later stages. Both Reese[6] and Burke[7] have stated that later stages of glaucoma show a strong tendency toward further progression of the disease in spite of normalization of tension.

The investigation conducted by the Philadelphia Committee for Prevention of Blindness is an attempt to ferret out the cases in the uncertain stage of glaucoma and to determine what can be done from a public health and case-work point of view to control blindness. This calls for the closest cooperation between physician and patient and, if handled through a clinic, the aid of a skilled case worker.

Such coöperation, however, can only be developed if the physician himself is aware constantly of the need for an early diagnosis in glaucoma. As Derrick Vail[8] said:

"We must think of glaucoma as the western-bound travellers thought of Indians in the 1850s. They actually 'looked for an Indian behind every tree.' We must look for

* Not all of this potential group will be ruled out. It is our belief that 10, possibly more, have early glaucoma. The rate will be close to two percent.

glaucoma within every normal appearing eye. It is our feeling that such an awareness can be created by taking more intraocular-pressure readings, not only once but over a period of time, in an effort to confirm or disprove the need for further diagnostic study."

Kronfeld[9] said that the taking of multiple tonometric readings would, in the long run, uncover as much information as could be gained by provocative tests. It is on this basis that we have operated, since performing provocative tests is beyond the simple limits of our mass examinations.

The results of this preliminary study would seem to indicate that approximately two percent of persons over 40 years of age have early changes indicative of oncoming or actual glaucoma. There may be only a slight elevation of tension. Frequently, however, there is an enlargement of the blind-spot or a difference in pressure of more than four mm. Hg between the involved eye and the so-called normal eye.

These are the cases which, unless properly followed, may sooner or later show a loss of vision and a loss of field. We have made no attempt to classify our findings. Our purpose is not to distinguish narrow-angle, wide-angle, or any particular type of glaucoma. It is our aim to discover any rise in ocular tension and then refer the individual for provocative tests, field studies, and prolonged supervision.

The more we deliberate upon findings from this study—incidence of glaucoma, other ocular and systemic conditions which have been uncovered, and the pitifully few persons who have had the benefit of ophthalmic advice—the more fixed is our belief that Mohammed will have to go to the mountain. In some way it must be made possible to give visual examinations to large numbers of people more regularly and with closer scrutiny and better follow-up than is done today.

Through coöperation with industrial groups (both medical and administrative), medical societies, and labor unions a proper stimulus might be developed to include in the routine physical examination given at the time of employment (for persons past 40 years of age) the simple examination we have used to locate symptoms of early glaucoma.

Continued demonstrations, such as the Philadelphia Committee for Prevention of Blindness is making, together with an effective educational program designed to reach employers has been the ground work for practically all other pioneering in the interest of public health.

If we are to believe that glaucoma should be found early in order that medical science may function fully, then this method we present for consideration, or some other more effective one, should be set in motion widely and without delay.

1831 Chestnut Street.

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NOTES, CASES, INSTRUMENTS

SOME OBSERVATIONS ON THE TRACHOMA PROBLEM

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Haifa, State of Israel

A review of the trachoma literature shows detailed bacteriologic and histologic studies but it fails to reveal adequate descriptions of the general condition of patients suffering from this disease.

Axenfeld, who even went so far as to infect himself with the disease in order to study the results, is of the opinion that there exist different kinds of inflammation of the palpebroconjunctiva, only one of which is trachoma.

Kapuszinzki (1921) reports 55 cases of autoinfection among men who tried to get trachoma in order to avoid military service. Of these 55 cases, 9 showed typical trachoma; 4 hypertrophia with enlarged papillas; 19, a velvety aspect of the mucous membranes; 3, catarrh; and 20, a normal state.

From Kapuszinski's study, it is clear that agricultural laborers, in particular, remained immune against infection with trachoma. During the period covered by his report (1917-18), there was a scarcity of food in that locale (environs of Cracow) but, as is well known, the agricultural population always suffers least during such a scarcity.

Wilson, head of the antitrachoma service in Egypt, wrote in 1944: "No progress has been made, and even now practically every single pupil has the disease, with the exception of a small percentage (0.5 to 1.5 percent) belonging to the well-to-do classes."

Mirenburg (1948), writing on trachoma in Jerusalem, shows the incidence of the disease to be considerably less among the children of the Ashkenasic Jews of higher economic level than in the families of the poorer and more prolific Sephardic Jews.

During my period of service at the trachoma station of the II. Ophthalmological Clinic, University of Vienna, I noted that neither a nurse nor a physician was ever infected with trachoma.

Both a survey of the literature and my own observations extending over 25 years have made me of the opinion that an individual's general nutrition is a decisive factor in his immunity or lack of immunity in this infectious eye disease. Furthermore, it is my belief that proper diet—including fresh milk and fresh, green vegetables—will shorten the duration of trachoma or actually heal it.

In the eastern part of the Mediterranean basin (Palestine, Syria, Lebanon), the rainy season usually begins in November and lasts until March or April. During this period of rain, there is plenty of green fodder for the cattle and the milk yield increases. The native population also picks wild plants and herbs (rich sources of calcium) and prepare them for salads.

From June to November, however, all vegetation is burned up and the milk supply is scarce.

It is worth noting that the incidence of eye inflammations shows a sharp increase at the end of May, an increase which lasts until the beginning of December.

My peasant patients come from very different parts of the country. In a Lebanon village, at an altitude of 1,000 meters, with plenty of rainfall which makes the growing of vegetables possible, families of nine children between the ages of 3 to 17 years show no signs of trachoma. In neighboring villages with insufficient rainfall to produce adequate supplies of milk and green vegetables, practically 100 percent of the children have trachoma.

During tarsus resections in adults, I have observed that, if cases of trachoma have not been treated, the granules gradually become calcified and that, when this occurs, the inflammation remains stationary.

It is my considered conclusion that cal-

cium can control the organism producing trachoma and that, if an individual has sufficient milk, milk products, and fresh, green vegetables in his diet, he will remain immune to a conjunctivitis which may later become trachoma.

Furthermore, relying on these observations, I have successfully employed the following therapy in thousands of cases of trachoma in children:

Corn flour boiled in milk to which are added 2 to 3 tablets of desterol-calcium (for small children) and 3 to 5 tablets of desterol-calcium (for older children). Local treatment with Hydrargyrum percipitatum flavum (one percent) once daily. Cold sterile water is used to wash the eyes 3 to 4 times daily.

Following this course of therapy invariably leads to a complete cure within 10 to 14 days.

P.O. Box 234.

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CLEAR-VIEW LENS FRAME FOR THE BREWSTER STEREOSCOPE*

Emanuel Krimsky, M.D.
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The inspection of the eyes of convergently cross-eyed children, especially the younger ones with narrow interpupillary distance, through a stereoscope viewing frame requires a minimum of obstruction by structures which cover the nasal portions of the eyes.

In my stercoscopes,† I was able to reduce this shortcoming to a marked extent by doing away with the familiar caboose-type viewing head, and by substituting a simple viewing lens frame (fig. 1).

Although I was able, with this simpler arrangement, to observe the corneal light reflexes in marked cases of convergent squint, the question was occasionally raised as to whether inspection of the eyes was at all times easily possible in the extreme case of convergent squint.

In the improved viewing head herein presented (fig. 2), I have freed the inner framework support for the viewing lenses and have, therefore, been able to observe without difficulty the extreme type of convergent squint.

Fig. 1 (Krimsky). Nasal portion of the eyes partly obscured by lens frame.

Fig. 2 (Krimsky). Inner framework has been removed to enable easy inspection of eyes.

* Presented at the American Academy of Ophthalmology and Otolaryngology, Chicago, 1948.

† Krimsky, E.: Arch. Ophth., 26:808-815, 1941.

DETACHED IRIS FLOCCULUS*

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The following conditions characterize a case of a free floating cyst in the anterior chamber: (1) Free floating bodies in the anterior chamber may be solid or cystic with variation in shape and pigmentation. Most of these bodies have their origin in two sources, namely (a) from remnants of the pupillary membrane which are frequently present in these cases, and (b) from detached flocculi at the pupillary margin. The cystic variety probably belong to the latter category.

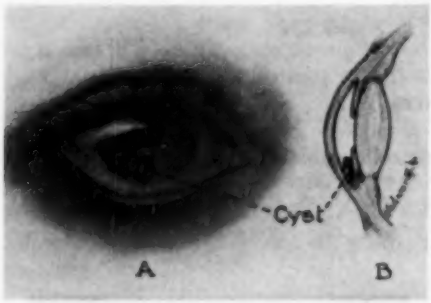

Fig. 1 (Reeh). Anterior chamber containing light-black, free-floating cyst.

CASE REPORT

History. S. V. O., a white boy, aged six years, was seen originally September 12, 1947. The child's mother stated that she first noted a small, dark, free floating body in the anterior chamber of the left eye. This body grew constantly in size until it became large enough to disturb the child. The child could cause the cyst to float about freely by changing positions of the head. There was no history of previous inflammation and it did not cause pain.

Eye examination. The visual acuity was: O.D. 20/20; O.S., 20/40—3, correctible to 20/25. The right eye was entirely normal. The lids of the left eye were normal. The anterior segment of the left eye was normal with the exception of a light black, thin-walled, pear-shaped cyst, approximately 2 by 2.5 mm. in size. It was freely moveable in the anterior chamber (fig. 1). The iris was normal. There was no evidence of active or quiescent inflammation noted by study with the slitlamp and corneal microscope. The pupil was circular, regular, and reacted normally to light. The lens was normal. The vitreous was clear and the fundus was normal.

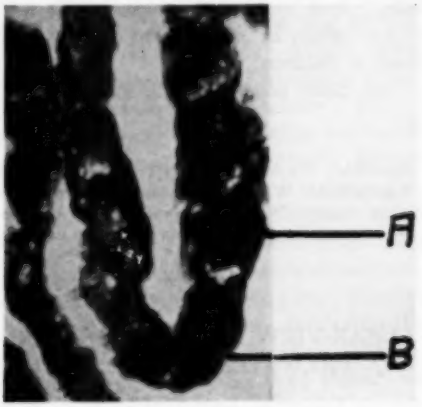

Fig. 2 (Reeh). High-power view of wall of cyst, showing single layer of pigmented cells (A) and hyaline basal membrane (B).

Operation. On September 15, 1947, the cyst was removed through a small limbal wound. It ruptured despite extreme gentleness used in its delivery. The wound healed readily without complications.

Pathology. (fig. 2). The cyst has an extremely thin wall composed of a single layer of large pigmented polyhedral cells resembling the posterior layer of cells of the iris. These cells contained round granules of pigment unevenly scattered throughout the cells, in parts absent completely, presenting a cystic appearance to the cell. The cells were set upon an extremely thin, delicate, pink-staining, amorphous, glass membrane-

* From the Department of Pathology, Providence Hospital. Dr. Jeff Minckler, pathologist.

like structure. No blood vessels or actual connective tissue could be seen.

Comment. This dark, thin-walled, pear-shaped, free-floating cyst represents a detached iris flocculus.

919 Taylor Street Building (5).

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TREATMENT OF DENDRITIC KERATITIS WITH AUREOMYCIN*

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AND

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Aureomycin is an antibiotic developed by Duggar at Lederle Laboratories and found by Braley to be extremely effective in a variety of ocular inflammations. We wish to report the successful use of topically applied aureomycin in dendritic keratitis. One drop of a 0.5-percent solution was instilled in the conjunctival sac every 1 or 2 hours while the patient was awake.

Seven cases of acute dendritic keratitis were treated with aureomycin and clinical cures were obtained in from 4 to 21 days. A direct relation existed between the size of the original corneal defect at the time treatment was initiated and the time required for complete healing. In two ulcers involving 80 percent of the cornea, healing required 17 to 21 days, respectively, while a small dendritic ulcer which had persisted for only two days cleared in 96 hours.

Subjective symptoms in all cases were relieved within two days, although large epithelial defects were still present. Clinical improvement was evident within two days in all cases but the rate of epithelization was directly proportional to the size of the original defect.

Only one of our seven patients had been treated with any other drug. Case 7 had been treated with Gifford's iodine solution three times without effect. Symptoms had persisted for 10 days before therapy with aureomycin was begun, and 21 days were required for complete healing, although there was subjective improvement within 48 hours.

Two cases of herpes zoster ophthalmicus with corneal ulcer were treated. In one case, in which ocular signs had been present only two days, the course was similar to that seen in dendritic keratitis. There was complete healing in five days. The associated supraorbital neuralgia was not affected by the therapy. In the second case local application of aureomycin had no effect on the course of the disease.

TABLE 1

CASES OF DENDRITIC KERATITIS

Case	Duration of Symptoms before Aureomycin (days)	Days before Symptoms Improved	Days before Findings Improved	Days before Cornea Completely Healed
1	2	1	1	7
2	3	2	2	17
3	2	1	1	8
4	2	1	2	11
5	3	1	1	4
6	3	2	2	4
7	10	2	3	21

It is, of course, impossible to draw conclusions from such a small series of cases but it appears that aureomycin is a drug of choice in the therapy of dendritic keratitis.

Since this paper was submitted for publication, we have observed more cases and are convinced that the earlier in the disease the aureomycin is started, the more likely that a cure will result.

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Cook County Hospital.

* The aureomycin (Duomycin) was kindly supplied by Lederle Laboratories.

SPECIAL NEEDLES FOR ELECTROLYSIS AND DIATHERMY OPERATIONS FOR RETINAL DETACHMENTS*

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New York

The Greishaber needles of Vogt previously used in operations for the separation of the retina were found to be difficult to manipulate under various types of retractors and spatulas because of the bend in the shaft. Furthermore, penetration into the sclera was difficult due to the fact that the needles were not tapered sufficiently.

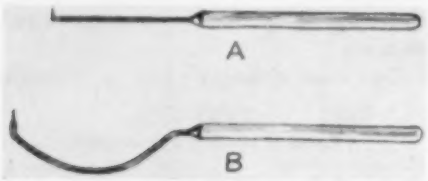

Fig. 1 (Berens). (A) Special needle for electrolysis and diathermy for operations for retinal detachments to fit Walker handle (1.0 to 2.5 mm. in length. (B) Special retinal needle for tears near the optic nerve, curved to fit the normal contour of the globe.

Special needles were devised to fit the Walker handle (fig. 1-A), made with a straight shaft with the needle emerging directly from the shaft. These needles are more easily manipulated, especially under an illuminated retractor.[1] The needles which are 1.0 to 2.5 mm. in length, when used with electrolysis, encourage the proliferation of the episcleral connective tissue into the wound which results in firm scars.[2] These new needles are tapered and almost conical; this construction, combined with unusually sharp points, facilitates penetration of the sclera without undue pressure even when only 1 or 2 milliamperes of current is employed.

A second type of special retinal needle has been made for tears near the optic nerve. The shaft, 30 mm. in length, fits into the Walker handle and the remainder is curved to fit the normal contour of the globe (fig. 1-B), and the needles (1.0 to 2.5 mm. in length) emerge directly from the shaft.

The curved needle is especially valuable in facilitating the application of electrolysis or diathermy punctures in detachments near the macular region.

708 Park Avenue (21).

* This work was aided by a grant from the Ophthalmological Foundation, Inc. The needles are made by V. Mueller & Co., Chicago.

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SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

April 4, 1949

DR. BENJAMIN ESTERMAN, *president*

IMPORTANCE OF AN ACCURATE HISTORY IN OPHTHALMIC DIAGNOSES

DR. JAMES W. SMITH discussed this subject during the Instruction Period.

ROUND-TABLE CONFERENCE

Medico-Ophthalmic Problems

SKIN FINDINGS IN ACUTE LUPUS ERYTHEMATOSUS

DR. SAMUEL PECK said that the relationship between the acute and chronic lupus erythematosus is not yet clear. Transitions between the two forms are known. While the acute form may occur in all ages, the majority of the patients are in the 20- to 40-year age group. The sex factor is very important in this disease. About three times as many females as males have been found in most statistical presentations.

A number of factors may change the chronic lupus erythematosus into the acute form. Especially important is the exposure to sun and strong artificial light. Dr. Peck cited a case in which the patient, who had a rather quiescent discoid lupus erythematosus, needed prolonged dental therapy. For a number of days she was exposed to strong artificial light so that she complained of the heat of the lamp. A few weeks after the dental treatment, the disease became much worse and is now going on into the subacute form.

Gold therapy, which is one of the favorite drugs for the treatment of discoid lupus erythematosus, has been known to produce an acute exacerbation. However, in many cases the disease has an onset like an acute infectious process without any preceding discoid lupus erythematosus having been present. In acute cases the onset is sudden, with chills and high temperature.

Some cases may begin rather insidiously and have a mild form, especially in the first attack, with very little skin manifestation and relatively little fever or none at all. These patients, however, commonly complain of excessive fatigue. The skin lesions are typically found on the more exposed parts of the body, that is the face, the ears, the v-shaped exposed part of the chest, and the hands. Characteristic is the butterfly- or bat-shaped erythema covering the nose and the malar prominences. The ears (especially the upper part of the helix), the chin, and the neck may also be involved. The erythema is nearly always edematous, or even vesiculated in severe cases.

In its early stages it is often confused with erysipelas. However, its symmetry and its development from a small number of erythematous lesions, and the prolonged course of the disease usually differentiates the two. Another very important differential point, as pointed out by Weiner, is in the edema; the follicles appear more open, creating a surface that resembles an orange peel. Also very characteristic is the simultaneous involvement of the scalp and the fingers.

The erythematous eruption may rapidly spread over the body in large areas. In the acute, fulminating type, there are exudative features, such as blisters and crusts, so that the case has the appearance of an impetigo or even a pemphigus. Hemorrhagic lesions of purpuric type are also not uncommon. The erythema perstans of the face may persist throughout the whole disease while the manifestations on the rest of the body come and go.

Cases have been reported in which the skin lesions appear almost eczematous and they may resemble a roseola, or be morbiliform. The lesions may appear in crops and fade. However, the lesions on the exposed parts of the body, where they are usually first seen, are definitely more infiltrated and tend to persist. Diagnostically the cutaneous part of the disease is the most important. Commonly with the skin eruption we may have lymphadenitis and arthritis, although arthralgia without true arthritis is more common as in other septic processes. The spleen is often enlarged. Nephritis with a high albumin content of the urine is an early complication. Hematoporphyrin in the urine is frequently found in the severe cases of this disease. It has been given as the explanation for the marked photosensitivity in this disease.

Endocarditis, myocarditis, and bronchopneumonia are also not uncommon complicating factors and, together with the renal involvement, may be the immediate cause of death. Blood cultures are negative, although occasionally streptococci and even staphylococci have been found. These have not been given any etiologic significance. While leukocytosis may occasionally be found, it is the leukopenia, which is often below 3,000, that is diagnostic. These low counts are found in spite of the accompanying endocarditis or pneumonia. Apparently it is the granulocytes which are hit the hardest in this leukopenia, and a bad prognostic sign is the disappearance of the eosinophiles. Secondary anemia is frequent and the sedimentation rate is often increased.

Siemens has reported the rare occurrence of the transition of the acute type into the relatively benign discoid type. The Libman-Sacks syndrome, which consists of verrucous endocarditis, is different from that in rheumatic fever but the absence of Aschoff bodies accompanied by erythema perstans of the face has been reported. In this syndrome young women were most frequently affected and the majority, in combination with the heart ailment, had what could be called erythematosus; in others there was just a transient erythema. Probably the Libman-Sacks syndrome may represent a varient of true acute lupus erythematosus.

Baehr, Klemperer, and Schifrin have described the pathology of the disease. It consists primarily of vascular involvement with capillary dilation, endothelial proliferation, and a peculiar hyalin degeneration. Thrombosis and extravasation were found in all viscera. Frequently these changes were found in the skin and the kidney. Klemperer and his associates have put forward a new theory to explain the changes in lupus erythematosus which is based upon physical-chemical alterations in the fibers and ground substance of the connective tissue.

Eye findings in acute lupus erythematosus

Dr. Eugene M. Blake said that several fundamental changes in the body in this complex disease help to explain the polymorphic changes found in the eye. Age alone is one such element. Since lupus erythematosus may occur at any age, it is not surprising that the fundus picture would vary due to the normal variations of this factor. Again, the disease is common in women at puberty and the menopause, so that there is added the factor of endocrine disturbances. Certainly from the fact that renal involvement is so frequent, it is plain that chorioretinal changes ascribable to this complication add to the different pictures seen with the ophthalmoscope.

Bergmeister and Pillat have each stated that the intraocular lesions are metastatic tubercles in the retina and choroid and, in spite of the fact that tuberculosis is not generally believed to be cause of lupus erythematosus, we can at least imagine the fundus picture. Brocq's theory of the causes as being due to toxins from infectious foci, the so-called "vascular concept," and the possibility of allergy all permit one to

imagine the variations in the fundus picture.

Pathologic studies of lupus erythematosus have described three discernible changes: (1) Capillary dilatation with extravasations of blood and serum, (2) proliferation of the endothelium of the vessels, with formation of thrombi, and (3) degenerative and necrotizing lesions in the walls of capillaries, arterioles, and venules, frequently with hemorrhages.

Such pathologic processes explain the many and varied pictures seen with the ophthalmoscope. There may be disseminated chorioditis, old and active. The retina may show hemorrhages and exudates, white dots in the macula, at times dilated vessels, peri-arteritis and periphlebitis, fibrosis of the veins and arterioles. Late in the disease, many changes may be found in the optic nervehead, ranging from simple hyperemia and blurring of the nerve borders to papilledema, and primary or secondary optic atrophy. Most often the changes are centered in the retina and choroid. Under the microscope, the ocular changes are seen as edema and hemorrhages, especially in the nerve-fiber layer, hyalin degenerations of the intima of vessels, round-cell infiltration, and cytoid bodies.

Which case will develop malignant exophthalmos after thyroidectomy

Dr. Isadore Givner, giving the ophthalmologist's view, said that one cannot foretell every case that will develop malignant exophthalmus after thyroidectomy, but many cases can be recognized as potential candidates for this condition. Malignant exophthalmos after thyroidectomy is three times more frequent in men than in women. It usually occurs around the age of 54 years in men; 47 years in women. Of greatest importance is the early and dominant occurrence of eye symptoms rather than general systemic signs of hyperthyroidism. The presence of chemosis of the conjunctiva, edema of the lids, and congestion of the conjunctival veins in a patient of this age group following thyroidectomy, whether it be surgical or medical by means of propyl thiouracil, should suggest the possibility that the malignant type of uncontrolled exophthalmus may develop.

Dr. Louis Leiter, giving the internist's view, said that the possibility of postthyroidectomy aggravation should be seriously considered when the degree of exopthalmos is disproportionate to the size of the thyroid; when hyperthyroidism is easily controlled with iodine; in "super-response" yield of minus basal metabolic rate levels; when there is an increase in exophthalmos with the use of antithyroid drugs such as propyl thiouracil; if TSH tests on urine show much larger amounts than is normal for ordinary toxic goiter.

Other signs, said Dr. Leiter, are increased exophthalmos after X-ray irradiation of thyroid; or recurrence of exophthalmos after initial subtotal thyroidectomy with relatively little hyperthyroidism.

Eye manifestations and treatment of acne rosacea

Dr. Samuel Peck said that this syndrome has multiple causes, and it usually develops after the age of 30 years. It affects exclusively the skin of the face, and is most marked over the nose, forehead, cheeks, and chin. In the beginning these areas show slight transient redness, particularly after hot drinks or meals, exposure to heat and cold, nervous excitement, and at menstruation. Dilated capillaries, small red papules or pustules, or even nodules develop. In later and advanced stages it may lead to hypertrophy of the sebaceous glands and of connective tissue, and ultimately to lobulated purplish tumors, the so-called rhinophyma.

As far as the eye is concerned, occasionally an associated conjunctivitis or keratitis accompanies the cutaneous symptoms. These eye involvements tend to persist until the disease itself is influenced. However, even after local and systemic treatments seem to lead to fairly good results as far as the

skin manifestations are concerned, the changes in the eye often persist and progress.

Kissmeyer stated that both the bulbar and palpebral conjunctiva may be the seat of dilation of vessels and diffuse inflammation often accompanied by a marginal blepharitis. The corneal changes consist of a well-defined pannus composed of fine vessels extending from the margin toward the center of the cornea. Ulcers preceded by abrasions, accompanied by infiltration and vascularization may end in scar formation and impairment of vision.

The systemic treatment is of importance for acne rosacea involving the eye. Especially important is the avoidance of alcohol and hot beverages and reduction of either carbohydrates or fats in the diet. Especial attention must be paid to inflammatory conditions of the sinuses, since they play an important role. Dilute hydrochloric acid taken before meals very often is helpful even when a hypochlorhydria is not manifest. Vitamin-B complex taken with the acid, as well as administration of calcium lactate on an empty stomach, often favorably influences the course of the disease.

The dermatologist is aided, of course, in the treatment of acne rosacea of the skin by application of various ointments, lotions, and X rays. The combination of systemic and local therapy results very often in amelioration of the skin manifestations while the eye symptoms are still active. Recently it has been proposed that superficial doses of X ray, as are given in dermatologic procedures, should be given directly to the conjunctiva. Dr. Peck also suggested the use of a mild local antiseptic such as sodium-propionate solution to avoid secondary ulcerations if they can be proved to be of bacterial origin.

Implantation of Undifferentiated Tissue in the Anterior Chamber of Animal Eyes

Dr. Eugene M. Blake said that undifferentiated embryonal tissue will often develop into that of some definite organ tissue in the anterior chamber. This is, of course, of no great clinical importance but the knowledge of this fact can be made of practical value.

Anaplastic tumor tissue, in which the cells are not well differentiated or in which necrosis has set in, when grown in the anterior chamber, will fairly often develop into well-defined cells so that it is possible to say that the anaplastic tissue is a metastasis from a certain organ. For instance, an enlarged lymph node from the neck gave no clear picture of its nature until grown in the eye. Microscopic study of the tissue grown in the anterior chamber suggested that it contained kidney cells. The surgeon restudied the patient with this idea in mind and found a malignant tumor in one kidney.

In one case, a bit of tissue, removed from the edge of the eyelid, showed, under the microscope, the structure of a basal-cell carcinoma; after implantation and growth, it proved to be a metastatic tumor from a pigmented nevus of another part removed 17 years before.

Unfortunately, not all biopsy tissue which contains undifferentiated tissue will produce differentiated cells. The implant may simply show an abundance of undifferentiated cells. The pathologist is not able to tell beforehand just which pieces of tissue will differentiate. But the knowledge which is gained from those cases in which undifferentiated tissue develops into recognizable cells of different structures of the adult type is certainly a step forward, and it may be that, as time goes on, it will be possible with greater frequency to learn from the implantation of anaplastic tissue the true nature of the cells and to permit the surgeon to determine with more accuracy the real type of cell and its clinical importance.

Such an implant remains without visible change for several days and may even undergo a slight increase in size before vascularization occurs. It seems probable that,

during this period, the tumor stroma, representing normal tissue from the donor, dies and disintegrates, while the parenchymal cells, representing essential tumor elements, continue to live, obtaining nutriment from surrounding media in the manner of a tissue culture. Eventually, the implant consists only of essential tumor cells. The ability to survive and grow in the anterior chamber of an alien host is a property common to malignant and embryonal tissue, and this property is not shared by normal adult or benign tumor tissue.

Ocular changes from nutritional deficiencies

Dr. Isadore Givner said that attention was first called to the relationship of some cases of burning of the eyes and vitamin-C deficiency by a young dentist. This patient was being treated for an ulcer of the stomach and he kept away from all citrus fruits. A vitamin-C blood determination showed a reading below normal. After taking 300 mg. vitamin C daily for one week, the burning of his eyes disappeared. On a maintenance dose of 100 mg. daily the symptoms did not recur. Since then over 20 such cases have been helped. Even though there may be other causes for the burning, attention should should be called to the vitamin C as a possible factor.

In conjunction with Ferra and Roizin, ocular changes in rats on diets deficient in amino acids were studied. Rose and his coworkers had shown that, of the 22 most important amino acids, 10 are necessary to growing animals and 8 are necessary for the maintenance of the nitrogen equilibrium in adult men. One of these amino acids is valine.

In a study of 12 albino rats of the Sherman strain on a valine-deficient diet, ocular changes occurred in 4½ to 5 weeks after the beginning of the experiment. They consisted of a progressive lack of luster of the corneas followed by a loss of transparency, due to edema. As the condition progressed, dryness of the cornea developed, involving chiefly the interpalpebral area. The lens showed only slight changes and the rest of the eye showed no abnormalities. Histologically, edema and degeneration of the epithelial cells of the superficial layers of the cornea were noticed. Shortly after administering the synthetic valine to the animals on the valine-deficient diet, the corneal edema disappeared and the corneas assumed their normal transparency.

Clinical application of these data was soon made; two cases of exfoliative dermatitis with corneal dystrophic changes similar to that seen in the valine-deficient rats were observed. At that time methods of determination of individual amino deficiency were not available. Subsequent to the parenteral administration of amino acids, amino acids by mouth and a high protein diet, the corneas cleared and eventually cleared completely with restoration of 20/20 vision from 20/100, O.D., and 20/40, O.S., in one case. In the second case vision returned to normal from 20/30 in both eyes. In both cases the total proteins were reduced, showing predominantly in the albumin faction (total protein 4.9, albumin 2.9, globulin 2).

A third case was seen recently in consultation with Dr. Jonathan Harris. This patient, R. C., aged 35 years, was seen in June, 1948. The patient had a marked corneal epithelial dystrophy from December, 1947, reducing vision to 20/40, O.D.; 20/100, O.S. Valine (two percent) used locally as drops in the eyes showed no benefit. A few weeks later after being given soy bean and vi-peptolac, a protein hydrolysate compound, Dr. Harris noted a clearing of the cornea, eventuating in 20/20 vision, O.S., 20/25, O.D., as well as marked constitutional improvement.

Reversibility of hypertensive retinopathy

Dr. Louis Leiter said that the reversibility of hypertensive retinopathy depended on the following factors:

1. Etiology. Acute glomerulonephritis, acute toxic nephrosis, preëclamptic toxemia, unilateral renal disease with hypertensive crises, or any other cause such as pheochromocytoma or relatively sudden rise in blood pressure in an individual without previous organic retinal vascular disease.

2. Absence of associated organic vascular disease in brain, retina, kidneys, aorta, (coarctation), and elsewhere. Good kidney function.

3. Absence of diabetes mellitus, Cushing's syndrome, or diffuse vascular disease.

4. Early recognition. Often dependent on chance circumstances and intelligence of the patient.

5. Nature of treatment. If medical, severe sodium restriction and depletion, chemical vasodilatation, accurately controlled, and relief of increased intracranial pressure; if surgical, sympathectomy, resection of stenosed aorta, adrenalectomy for pheochromocytoma or very rarely unilateral nephrectomy; if obstetrical, termination of pregnacy. Theory of mechanism of retinopathy is important in relation to primary goal of therapy; for example, relief of retinal arteriolar spasm or peripheral vasodilatation to lower general blood pressure.

Malignant and benign nevi

Dr. Samuel Peck said what is commonly called a mole is an intraepidermic nevus which can be classified clinically as a pigmented nevus or, if it contains hair, as nevus pigmentosus pilosus. This common pigmented mole can be seen on any part of the body, but has a predilection for the face. It may be flat or elevated and it may range in size from a few millimeters to several centimeters. The color may be any shade of brown, or even that of the normal skin. The surface is usually smooth. In most instances it develops early in life and remains stationary. When the diagnosis of the common intraepidermic nevus is made, the mole can be left alone or treated in any conventional manner, such as electrodesiccation, electrolysis, or trichloracetic acid. Here removal is for cosmetic purposes only and the method which gives the best cosmetic result should be used.

The so-called blue nevus is of mesodermic origin and is situated in the cutis. Bluish-black in color, it can be found most any place on the body but it seems to have a predilection for the back, especially the buttocks. No one has reported a malignant lesion developing from such a nevus.

The junction nevus is considered by many authorities to be a forerunner of a nevocarcinoma. The only certain way to make a diagnosis of this type of nevus is by biopsy. There should be no hesitation to do a biopsy since everyone who has had a great deal to do with such lesions believes that a biopsy does not initiate malignant change, not even if we are dealing with a nevocarcinoma does it tend to disseminate the lesion.

Clinically, it may be a pea-sized lesion or larger, flat, or somewhat raised and smooth. It is usually nonhairy. It is for this reason that it is stated that hairy moles are not the type which become malignant. However, this is not an absolute criteria for differential diagnosis between the ordinary mole and the junction nevus.

A good rule to follow is that alteration in the color, size, development of ulceration, and inflammation, bleeding, tendency to crust formation, or tenderness in a nevus which has existed for some time without change is suspicious of a beginning malignancy.

Role of vasodilators in ocular therapy

Dr. Eugene Blake said that, according to Dr. Walter Duggan, whose theory has considerable to support it, the early pathologic picture of many intra- and extraocular lesions can be ascribed to increased capillary permeability and arteriolar spasm with resulting tissue anoxia. These changes consist of localized edema and round-cell infiltration, corresponding to Ricker's stages of

prestasis and peristasis. There is also capillary and venular dilation and round-cell infiltration which is perivascular.

The focal nature of these lesions must be due to a hypersensitivity of one or more arteriolar-capillary units, thus accounting for the sharply localized lesions.

Capillary permeability is increased beyond physiologic limits by lack of available oxygen in the circulating blood (Landis), by lack of ascorbic acid, by histamine, by certain drugs, and by spasm of the arterioles supplying the involved capillaries.

Arteriolar spasm can be caused by overaction of the sympathetic nervous system, by an increase of epinephrine in the circulating blood, by nicotine, by histamine or histaminelike bodies, and by a decreased formation, or an increased destruction, of acetylcholine which is the vasodilator hormone of the body.

Histamine is said to act by augmenting the action of acetylcholine; so lack of thiamine may cause arteriolar spasm. Nicotinic acid is also a vasodilator. Thiamine, nicotinic acid, and riboflavin all seem to be concerned with oxidative processes in the body. Another contributing factor may be temporary alkalosis.

Histamine or histaminelike bodies are probably the major etiologic factors in arteriolar spasm and resulting anoxia. All agents which, by virtue of their presence or absence, can increase the permeability of the capillaries, cause arteriolar spasm, or, like histamine, bring about both effects, are possible etiologic factors.

Allergy presupposes previous sensitization by a protein.

Histamine, or histaminelike bodies, has been suggested as a likely agent, because histamine is the only substance occurring normally in the body which can cause arteriolar constriction and capillary dilation with increased capillary permeability. The degree of the latter will determine whether plasma, white or red blood cells pass into the tissue with a resulting perivascular edema, lymphocytic infiltration, or an accumulation of the red blood cells.

Hypersensitivity of one or more arteriolar-capillary units to histamine, or to a histaminelike substance, explains the focal nature of these lesions. A relative lack of histaminase may be the factor whereby histamine is able to enter the circulation in one region of the body and act on histamine-sensitive cells at some remote point of the body.

In his experience, Dr. Blake said that the use of vasodilators in ophthalmology is confined largely to administration of sodium nitrite. In several cases of early optic atrophy, this drug improved the circulation, through the dilated vessels, and resulted in unexpectedly good vision.

Another condition in which it seems reasonable to hope for better results through vasodilators is the treatment of pigmentary degeneration of the retina. Whether the markedly contracted arterioles seen in the fundus are the partial cause of the degeneration of the nervous tissue or the result, it appears wholly reasonable to think that vasodilation is indicated. Dr. Blake said that he is using vasodilators in retinitis pigmentosa with subjective improvement.

Ocular findings in Kaposi's varicelliform dermatitis

Dr. Isadore Givner said that Kaposi, in 1887, defined this disease which is a specific variolate form manifestation of herpes. The skin lesion resembles smallpox and chickenpox. The onset is sudden and new lesions appear for several days. Umbilicated erythematous vesicular elements rapidly develop on the face, head, neck, elbow, and wrists. They become pustular and desiccate. Scarring is common. Fever precedes the eruption by 24 hours and persists for 1 to 2 weeks, followed by lysis.

Of 67 cases, 53 had a preceding atopic dematitis. Barton and Brunsting demonstrated the herpes virus in one of their patients, as did Lynch. The disease is accepted

as due to a virus similar to, or a strain of, herpes virus.

Dr. Givner said that on November 11, 1948, he was called to examine a patient, C. B. J., a woman, aged 24 years. Her past history disclosed an atopic dermatitis of years' standing. In August, 1948, she noticed itching of the arms, neck, and shoulder followed by punctate lesions with umbilication over these areas. At the present time a typical varicelliform eruption covered her face, neck, and upper chest.

Both lids of both eyes showed broken vesicles at the edge of the lid margins. There was mucopus in the conjunctival sac but the corneas were clear. Culture of the conjunctiva showed hemolytic streptococci and hemolytic Staphylococcus aureus that was coagulase positive and fermented mannitol.

Reëxamination on November 17th showed each cornea affected with four large lesions of dendritic keratitis. The lesions were cauterized with ether but the progress was not halted. On November 19th, aureomycin was instilled locally every hour. In three days both corneas were completely healed. Vision when last seen was 20/20, O.U.

Etiology and diagnosis of sarcoid

Dr. Louis Leiter said that Longscope, in 1937, and Pinner, in 1945, concluded that the cause of Boeck's sarcoid was unknown. Pinner, however, leaned strongly toward a tuberculous etiology and called the disease "noncaseating tuberculosis" because some form of tuberculosis precedes, coexists with, or follows sarcoid in 10 percent of the cases. Its pathology—which consists of epithelioid tubercles without caseation, going to fibrosis and not containing demonstrable tubercle bacilli—resembles certain types of hematogenous tuberculosis in a sufficiently immune host. The usual lack of reaction to tuberculin in sarcoid can be explained in lack of caseation and toxemia, and absence or early disappearance of tubercle bacilli.

Dr. Leiter said that the proponents of the theory that sarcoid is nontuberculous in origin claim that its terminal association with tuberculosis may result from accidental breakdown of an old lesion by sarcoid extending into it. Marked tuberculin anergy and absence of caseation are powerful arguments against tuberculosis. Also, the distribution of sarcoidosis is unique, involving the salivary glands, small bones, myocardium, and so forth.

Among the clinical manifestations of sarcoid are: lymph-node involvement and salivary and lacrimal gland enlargement; iridocyclitis; bone changes in hands extending chiefly to bases; pulmonary lesions, which are stable; monocytosis, elevated plasma globulin; negative tuberculin to large doses; lymph-node biopsy; positive Kveim test; and long course and remissions with lack of definite response to treatment of the disease.

Seborrheic eczema of the eyelids

Dr. Samuel Peck said that the term seborrhea is limited to a functional disturbance, clinically not associated with evidences of inflammation. This disturbed function is most frequently found on the nose and paranasal skin, the areas of presterno and interscapular regions, the scalp, and the margins of the eyelids; in other words, wherever sebaceous glands are abundant.

Seborrheic dermatitis is a condition which is superimposed on the seborrheic skin. While the etiology of this dermatitis is obscure, bacteria and fungi probably play a role in its production, not only directly but also by setting up an allergic reaction at the same time. The dermatologist admits that, in certain types of seborrhea of the scalp, the pityrosporum ovale plays a role. Also, in seborrheic eczema in other parts of the body, especially in the folds, a monilla, among other bacterial inhabitants of the skin, is believed to play a role.

Treatment of seborrheic eczema of the eyelids differs in many ways from that of

seborrheic eczema in other parts of the skin because of the limitation of the use of topical remedies which may prove irritating to the eye. Whenever the dermatitis is acute, wet dressings are indicated. In the usual types, boric acid solution (two to three percent), or Burrow's solution (1 to 20), was a standard method of treatment.

Dr. Peck said that it was his opinion that in seborrheic eczema we are dealing with a disturbed metabolism which is probably characterized by a diminution of the fatty acids. Thus, the ordinary skin bacteria multiply and even gain a foothold where the normal secretions of the sebaceous glands would tend to keep the flora down by their bacteriostatic and fungistatic action. Finally, an allergic reaction is evidenced by the infectious eczematoid dermatitis. Therefore, it is logical to use bland wet dressings (such as five-percent sodium-propionate solution) which tend to replace the lost bacteriostatic and fungistatic action of the sebaceous glands.

Once the acute symptoms diminish, there is often left a blepharitis which is resistant to treatment. One of the standard methods of treatment is yellow oxide of mercury. This, however, has not been very efficacious. A much more satisfactory treatment has been the application of two- to five-percent sodium-propionate in a fatty base, such as aquaphore.

In recalcitrant cases, fractional X-ray therapy is very valuable. Here, again, we are faced with the old controversy: What is the possibility of damage to the eye when X-ray therapy is given to the lid? In more than 20 years' experience with the conservative use of small doses of superficial X rays, Dr. Peck said that he has never seen any damage. In many instances this was the most valuable therapeutic approach in initiating improvement. The systemic treatment is important, also. Carbohydrates and fats in the diet should be reduced. General hygiene, such as exposure to sunlight and outdoor exercise, should be recommended. In resistant cases, injections of crude liver extract are very helpful.

Role of Endocrines in Primary Glaucoma

Dr. Eugene Blake said that it is impossible to evaluate the role of the endocrines in primary glaucoma. Extracts or preparations of every gland in the hormone system have been used at one time or other in the treatment of primary glaucoma. One writer even tried an emulsion of ground-up lacrimal glands with very indifferent results.

Perhaps more has been done with pituitary extracts, anterior and posterior, than with any other glandular product. Jeandelize and Drouet studied the action of posterior pituitary extract and summarized their findings as follows: "There may be a coexistence of ocular hypertension and certain pituitary disturbances. In pregnancy, when the pituitary undergoes considerable alteration, there is hypertension. Pituitary extract seems to exert a hypotensive effect on glaucoma. The known facts do not allow more definite conclusions."

In discussing the spleen, F. A. Miller affirmed that primary glaucoma is an angioneurotic edema within the eyeball and that prompt relief followed the injection of deproteinized extract of the spleen. Another author used spleenic extract in eight cases and reported that it was of dubious value and this seems to be the opinion of those who tried this hormone.

Ivan de Frosz determined the content of follicular hormone in the urine and reported that, in the majority of cases, the excretion was deficient and recommended its use in young women with glaucoma and defective ovarian function. Dollfuss reported the study of two cases and found the excretion of folliculin was high.

Jayle and Schnacter mention the physiologic lowering of tension in pregnancy and that glaucoma almost never occurs during this state. Furthermore, hypotony is a feature of acromegaly, chorionic

pituitary adenoma, and the Babinski-Froelich syndrome.

Ferrari studied the action of the hormone of the suprarenal cortex and concluded that it has no effect upon the pupils or the intraocular pressure. It is not synergistic nor inhibitory to the pharmacodynamic action with adrenalin. Dr. Alan Woods also reported upon a careful study of the action of cortin and decided that it had no effect upon the glaucomatous eye. The use and action of adrenalin, and other drugs in this group, is so familiar that one need say no more than that its use is one of the most valuable forms of treatment we have.

Even in the employment of thyroid extract, there still appears to be the same lack of uniformity of results of this hormone in the treatment of primary glacouma. There are reports of good effects which have been enthusiastic. Dr. Blake said that he felt the basal metabolic rate should be known in all cases of primary glaucoma and, when this is lower than minus 10, he has found that administration of small doses of thyroid are beneficial in many cases. Others, however, have studied the basal metabolic rate in fairly large groups of glaucoma patients and reported that the rate is no lower than in similar groups of persons not having glaucoma.

In an excellent paper published about 25 years ago on this subject, Dr. Percy Fridenberg gave a fine outline of the role of the endocrines. He said: "In conclusion and summing up we may say that the application of endocrinology to glaucoma will be largely diagnostic and etiologic, with some reflections in pharmacology and pathologic anatomy. As to the therapeutic possibilities, we may well be rather guarded in promise and prospects. Of an effective antiglaucomatous hormone therapy we must unfortunately say, 'mellonta tauta,' for these things are still largely in the future."

Intravenous procaine in ophthalmology

Dr. Isadore Givner said that procaine intravenously has no effect on the ocular tension in normal individuals, or in cases with chronic glaucoma.

There was no beneficial effect following the use of procaine intravenously in retinal-vein thrombosis with the exception of one case. No effect was had in diabetic retinopathy.

Relief of pain ensued after the administration of procaine intravenously in the treatment of herpes zoster ophthalmicus. This relief was not permanent.

Marked continued relief of pain was experienced in one case of absolute glaucoma and in one case of hemorrhagic glaucoma.

Eye findings in toxemias of pregnancy

Dr. Louis Leiter said that the diagnostic value in distinguishing between relatively acute hypertensive toxemias and previously established hypertensive diseases is on a renal or "essential" basis. This would apply largely to older primiparas or other women in the latter part of child-bearing age since it takes years or decades for retinal arteriosclerosis and retinopathy to develop in the average case of chronic hypertensive disease.

The eye findings also have a prognostic value in gauging the course or rate of progress of toxemia in relation to the vascular system. Marked spasm, general or localized, or development of retinal edema, papilledema, or hemorrhages are indicators of impending eclampsia or other dire conditions and require rigorous treatment. Rapid subsidence of retinal changes pre- or post-delivery speaks for likelihood of complete vascular recovery.

Therapeutic importance of the eye findings is connected with decision as to degree of sodium restriction, use of sedation or vasodilators, and urgency of termination of pregnancy by one means or another.

Contact dermatitis limited to the eyelids

Dr. Samuel Peck said that there are three main categories of contact dermatitis

limited to the eyelids. The first was cosmetic, which is the most frequent and the most easily diagnosed. It usually involves the upper and lower lids. In the last few years it has been recognized that nail polish can cause an allergic dermatitis which is found only on the upper lids or even on one eyelid. The dermatitis is usually produced by the synthetic resin in the nail lacquer, or by a light sensitization produced by the dyes used in the nail polish. That all of these cosmetics cause dermatitis by sensitization can be proved by patch tests.

The second group of dermatitis is caused by local medication, such as eyedrops, eye ointments, and so forth. Here, however, the history will be suggestive. Also in this group both eyelids are usually involved.

Industrial irritants, which include dust and fumes, very often cause irritation of the eyelids before other parts of the body are affected. Here we may have both primary irritation as well as sensitization. In most instances there is usually also involvement of the conjunctiva; particularly after continued exposure.

The dermatitis of allergic nature is not due to a local sensitization. The anatomic structures, as well as the habits of the patient, determine the localization. The epidermis of the eyelid, especially the upper eyelid, is very thin so that allergens may readily come in contact with the living layers of the skin. Also, nearly everyone is in the habit of touching his eyelids frequently during the day. This is the reason for the localization of the nail polish dermatitis. Irritating dust and fumes not only attack the eyelids because of their anatomic structure, but also because these structures are very often contacted by these irritants.

Therapy in diabetic retinopathy

Dr. Eugene Blake said that one must realize that the retinal picture seen in the diabetic is not always, in fact probably rarely, due solely to the hyperglycemia and the failure of the secretion of the islands of Langerhans. Several facts substantiate this belief. First, one rarely sees retinal changes in the young diabetic, even if the blood sugar is high; secondly, a raised blood pressure and vascular disease very frequently accompany the diabetes, particularly in older people; and, thirdly, when the diabetes is controlled by insulin and diet, the retinal changes progress, although it would seem reasonable to expect them at least to be controlled.

When retinitis develops in the diabetic, associated findings usually include increased blood pressure, vascular disease, especially of the veins, and albumin, as well as sugar, in the urine. The actual percentage of blood sugar would appear to have little relation to the incidence of diabetic retinopathy, and the majority of patients who show such changes are those with mild hyperglycemia.

When discussing therapy, the diabetes, the blood pressure, the vascular sclerosis, the nephritis, and the patient's age must all be considered. In an article by Dr. MacLean and Dr. Brambel on the use of dicumarol and rutin in vascular diseases, it is said that some of the etiologic factors in diabetic retinopathy may be attributed to vascular sclerosis and that administration of an anticoagulant for a long time should be helpful in eliminating thrombosis.

Under dicumarol therapy, four cases of diabetic retinopathy showed improvement in vision and absorption of hemorrhages. No increase in capillary fragility was observed in these cases. Rutin was used in two of the cases. Improvement was attributed to the prevention of thrombosis by the anticoagulant. No recurrences developed during a treatment of many months.

The authors' conclusions are: (1) That long-continued use of dicumarol is efficacious in central serous retinopathy; (2) rutin decreases capillary fragility and has been used with benefit; (3) increased clotting time occurred; (4) improvement in visual acuity has been accomplished by

maintaining the prothrombin activity between 50 and 60 percent of normal.

Dr. Blake said that it has been his practice to urge the patient to follow the physician's treatment and diet, to watch the blood pressure, and to use rutin continuously. One of his experiences with dicumarol had been unfortunate.

Systemic abnormalities in retinitis pigmentosa

Dr. Isadore Givner said that no longer is it necessary to emphasize that retinitis pigmentosa is not a purely ocular disorder but rather a systemic disease, hereditary in nature, due to dysfunction of the autonomic and endocrine system, and manifested in the germinal anlage. A general survey of 16 cases showed:

1. No abnormalities in pulse rate, blood pressure, or temperature.

2. The serum cholesterol was within normal limits in 7 of 11 patients in whom the determination was made. In three patients it was only slightly elevated.

3. The basal metabolic rate was within normal limits for 8 of 13 patients. For five patients the rate varied from 15 to 21 percent below normal.

4. Thirteen patients had creatinuria. This group included 10 males (in which creatinuria is not found normally) and three females. It is felt that some hormonal factor of the pituitary gland is involved in the control of creatine metabolism. This may be defective in retinitis pigmentosa. Other observers have demonstrated thyrotropic substance in the urine, abnormalities of water and salt metabolism, diminished dextrose tolerance, and the presence of a melanophore—dispersing substance in the blood and urine as evidence of pituitary dysfunction in retinitis pigmentosa.

5. The spinal-fluid pressure was increased in 4 of 13 patients but readings in most of the other patients bordered on the upper limit of normal.

6. Hepatic damage was not demonstrable by the cephalin cholesterol flocculation procedure of Hanger in any of the 13 patients investigated.

7. The fasting ascorbic-acid content of the plasma was reduced in 9 of 11 patients.

8. In 12 patients pupillographic studies showed tenohaptic reactions and other evidences of diencephalic disorders.

9. An analysis of blood for retention of urea nitrogen and determination of specific gravity of urine after administration of pitressin failed to reveal any impairment of renal function in 15 patients.

10. Physical examination including neurologic studies gave essentially normal findings except for a high incidence of high arched palate and nerve deafness as revealed by audiometric tests.

11. In two patients capillary microscopy failed to reveal any abnormalities.

Focal infection in the causation of disease

Dr. Louis Leiter, in discussing this subject from an internist's point of view, said that the attitude of the internist toward focal infection should be cautious and conservative. He knows that a tonsillectomy does not prevent any chronic disease and at times may not prevent tonsillitis. He doubts that the gastro-intestinal and genitourinary tracts act as chronic foci of infection. The internist knows that occasionally an acute bursitis or iritis may follow closely upon a respiratory infection or a tooth abscess. Removal of such a focus is clearly indicated but, in the majority of alleged foci, one should insist on evidence of sufficient local disease. Even then removal of the focus of infection may have no value.

Bernard Kronenberg,
Recording Secretary.

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THE DOCTOR'S DILEMMA

MRS. DUBEDAT: Doctor: you must save my husband. You must. When I explain to you, you will see that you must. It is not an ordinary case, not like any other case. He is not like anybody else in the world: oh, believe me, he is not. I can prove it to you: (fingering her portfolio) I have brought some things to show you. And you can save him: the papers say you can. . . .

RIDGEON (huffily): I am not a curemonger: if you want cures, you must go to the people who sell them. (Recovering himself, ashamed of the tone of his voice) But I have at the hospital ten tuberculous patients whose lives I believe I can save.

MRS. DUBEDAT: Thank God!

RIDGEON: Wait a moment. Try to think of those ten patients as ten ship-wrecked men on a raft—a raft that is barely large enough to save them—that will not support one more. Another head bobs up through the waves at the side. Another man begs to be taken aboard. He implores the captain of the raft to save him. But the captain can only do that by pushing one of his ten off the raft and drowning him to make room for the new comer. That is what you are asking me to do.

MRS. DUBEDAT: But how can that be? I don't understand. Surely—

RIDGEON: You must take my word for it that it is so. My laboratory, my staff, and myself are working at full pressure. We are doing our utmost. The treatment is a new one. It takes time, means and skill; and there is not enough for another case. Our ten cases are already chosen cases. Do you understand what I mean by chosen?

The Doctor's Dilemma.
By George Bernard Shaw.

Four times since 1922 we have witnessed dramatic and miraculous results from the use of new drugs.

The first was the use of "iletin," later known an insulin, in a young girl in a diabetic coma hitherto invariably fatal. In a few moments, she opened her eyes and was fully conscious.

The second was the use of prontosil, later known as sulfanilamide, in a close friend dying of pneumonia. In a few days, he was on the way to complete recovery.

The third time was in a young soldier, in 1943, whose left eye was rapidly being lost as the result of gonorrheal ophthalmia. The purulent secretion, heavily loaded with gonococci, disappeared and the cloudy cornea rapidly cleared in a few hours after the use of penicillin, only recently available.

The fourth time was the use of ACTH in a young woman with rheumatoid arthritis, bilateral recurrent uveitis, and episcleritis. After a week's treatment with this new substance, her eyes were well and her arthritis gone, at least for the time being.

In each case the dilemma, so acutely described by Shaw, was strikingly present. The new drugs were pricelessly hard to get and the supply strictly limited for experimental uses. The selection of suitable patients had to be faced with courage and impartiality. Presumably, all patients were equally considered regardless of their financial or social status.

Except for ACTH, the new drugs became available for general use very shortly after the clinical trials had proved their value. We are all familiar, or should be, with the rapid production of insulin, the sulfonamides, and the mass production of the antibiotics, notably penicillin.

ACTH and cortisone, however, present a much more difficult problem of supplying the enormous demands. These substances are still scarce and their use is strictly limited. They are dispersed by the manufacturers only to recognized and responsible research groups for controlled study. There seems little prospect that they will be available for general use for several years to come.

ACTH is extracted from the hog pituitary, the only animal, other than man, in which there is a sufficient amount of hormone to provide a practical yield, which is only a tiny fraction of a percent of the original pituitary.

Perhaps it is just as well that ACTH cannot, as yet, be ordered from the corner drug store, for further studies, particularly directed to serious side-effects already discovered, must be made so that the limitations and indications for its use can be sharply defined.

This problem of supply, however, poses a poignant and heartbreaking drama at the moment. Because of necessity, the drug has to be discontinued and, as the result, the patient falls back into the depths of his disease after having attained for a brief interval the paradise of good health.

Ophthalmologists who have the rare privilege of trying this new substance in ocular conditions and in promising, suitable cases have a great responsibility to their colleagues and to the people not to permit the reports of their preliminary studies to splash across the front pages of the daily newspapers.

On the contrary, they should quietly, scientifically, and with humility toward their great trust, gather the evidence for the efficacy or for the dangers of ACTH therapy in ocular diseases. Otherwise, patients with hitherto incurable eye diseases and oculists who cannot get a supply of the drug, frustrated and miserable in their impotency, will create a new doctor's dilemma.

Derrick Vail.

ULTRAMODERN OFFICE PRACTICE

—1950—

The way things are today in the daily grind and practice of ophthalmology, it is a wonder we can find time to treat our pa-

tients. I wish people would quit finding out things, developing new drugs, inventing new instruments, new techniques, and even new diseases. I am late for dinner.

There was a time when all we needed to make a diagnosis was a good light (Welsbak burner, for example), a magnifying glass, a plane mirror with a hole in it, a simple handy ophthalmoscope without battery, wires, or rheostat, a set of trial lenses and a wire trial frame, a cardboard test chart, and our own trained senses to look, touch, feel, and listen.

All we needed to treat our patients were a few simple drugs like atropine, pilocarpine, silver nitrate, argyrol, yellow oxide of mercury ointment, and boric acid. To do a cataract operation we used (perhaps) a speculum, a Graefe knife, fixation and iris forceps, one pair of scissors, a cystotome, and a lens expressor or our own thumb, which we hoped was clean.

To take fields of vision and to test the ocular tension we used our own fingers and our good judgment. We may have, and probably did many times, missed early glaucoma; but on the other hand, if we did miss it, the patients missed a badly conceived and executed operation which brought on a premature end result.

All we had to read were a few skimpy journals and a big textbook, a very good one though, of which you may have heard. I mean Fuchs's *Textbook of Ophthalmology* with a fine chapter by Duane on ocular motility to which I turn even now when I want to learn something.

Our fees were low, but we could see a lot of patients in a day and do a lot of good by not doing anything very much, really, and in that way cover the ground with confidence and happiness in our ignorance and keep the affection of our patients.

Now what have we got? Well, a new patient comes in who wants a pair of glasses for reading because he is getting a little old and certainly looks it these days. We have to take a complete history, probing into his psyche and his Id on the side ("I don't get along so good with my wife's mother") and then—

Inspect the eyes (slitlamp, low and
High, contact lens, gonioscope, tonometer, and don't
Forget to use different weights [whoops, I dropped one]
On account of a
Thing recently discovered called scleral rigidity.)
Anterior segment (giantscope, Friedenwald ophthalmoscope
Plus twenty, slitlamp). Posterior segment
(Ditto one and nowadays ditto two with minus sixty
Hruby, and reflecting prism, costs a pot,
Binocular ophthalmoscope, think that's the lot).
Fundus photo, medico-legal, (Camera, hard to get
Costs as much as a new car yet.)
Fields of vision, peripheral and central,
(Feree-rand or maggiore, one by lloyd and a guy named
Bjerrum, test objects, clean and dirty,
And don't forget ANGIOSCOTOMETRY.)
Blood chemistry and X rays of the
Sinuses now, they need a culture.
The eyes are a little red, well ditto
(Swab, loop, slide, tube, stain, scope
Hell! why not the laboratory.)
Test his vision without glasses (projectochart)
What's he wearing? (lensometer)
Refract his eyes (refractor, keratometer,
Electric retinoscope, astigmometer,
Verhoeff chart, lancaster-regan dial chart
E chart, C chart, all around the room chart.)
Which are the blackest lines, mister?
They're all black says he.
Is this better or worse? well, I guess so.
Read the letters in the green line.
There ain't any, says he.
I mean, the ones sitting ON the green line
(Like ducks in a shooting gallery) Oh, THEM!
(Cross cylinder this way, that way.) The letters
Look much better without that thing, says he.
Now the muscles. (prisms in cascades
Like modern earrings.) Distance and
Near (flashlight, prisms, hard to handle and to hold
And a fist full at that; look, no hands!
Perimeter, maddox rod and wing and
Scale. Bjerrum, can't pronounce, screen.)
Rotations, excursions, ductions, npc, pch, gd,
Fusion tests (verhoeff's, worth's four dot, distance and
Near. Amblyoscope major, minor. After-image test.)
Please draw. Ah doc, I never could draw very well.
Diplopia tests. (Oh, God!) (red glass, green glass
Lancaster test.) (Don't be an ass,
Where the hell is that false image, like a football in a game,)
In front of me, in front of you, (and
After you find it what does it mean especially to

Mr. Spitalskyowitzz who doesn't understand ENGLISH!)
Meanwhile, while waiting for the reports we will
Have you try a little PENICILLIN.
No glasses yet, until we get the returns.

Well, next day the eyes are redder, and the next. So maybe penicillin isn't so good, so we'll try aureomycin, maybe bacitracin, streptomycin, chloromycetin. Maybe the patient is more sinned against than sinning. Let's try the sulfa drugs. No use! The eyes get much worse and worse. And the smears and cultures finally come back NEGATIVE. So we switch to physiologic salt solution and the eyes get WELL. At least, I've earned my fee.

"All I want is a pair of glasses for reading," says he. Georg Bartisch, 2nd.

CORRESPONDENCE

"THE DEPENDENCE OF SURGERY ON PHYSIOLOGY"

Editor

American Journal of Ophthalmology:

It is refreshing and encouraging to read Sir Stewart Duke-Elder's article entitled "The dependence of surgery on physiology: with special reference to the treatment of glaucoma," in the AMERICAN JOURNAL OF OPHTHALMOLOGY, January, 1950. I regard this contribution as one of the most valuable presented in the ophthalmic literature during recent years. Sir Stewart calls to task in no uncertain terms those ophthalmologists who think of glaucoma in terms of surgery and who use empirical and dogmatic methods of treatment contrary to simple logic and well-accepted truths in physiology.

I can visualize Sir Stewart with his fist pounding on the table driving home to the medical profession the fact that it has had a wrong concept of the processes of glaucoma and has blindly followed teachings of eye surgeons for five generations, believing that increased intraocular pressure and mechanical drainage by surgery is an accepted formula for a disease of unknown origin.

One is readily refreshed and takes new courage from his emphatic denunciation of the terms narrow- and wide-angle glaucoma and his criticism of the gonioscopic findings as an approach to the treatment for glaucoma. He drives home his message by pointing to the countless number of cases of blindness due to glaucoma despite our present method of diagnosis and treatment, but more particularly aiming at the surgeons who dogmatically teach a method of treatment implying relief or recovery of vision from which there was no relief or from which there was no vision.

Sir Stewart has plainly indicated that there is need of revamping the whole subject of glaucoma, particularly toward more rational thinking. He analyzes the various processes underlying glaucoma and throws overboard the cocksure teachings that give the student of ophthalmology the impression that glaucoma is an arithmetical problem for which one adds or subtracts or multiplies according to a prescribed formula.

His explanation that surgery is highly desirable and necessary is promptly acceptable and his explanation regarding inhibition of neuraxon reflexes is the explanation for the result rather than mechanical drainage, indicating that he has rationalized well, based upon years of personal experience rather than upon textbook information. Nowhere in his article do I find a recommendation of newly patented drugs for the control of intraocular pressure; nor do I find any easy formula—surgical, medical, or experimental—which is new or promising. I find, however, such realistic logic and simple common sense that his comments should be read and re-read by every student of ophthalmology.

We are now in the midst of an era of hysterical research on patented medicines, some accidentally discovered, which will cure a variety of diseases. The young student has been impressed with the fact that it must be new if it is worthwhile at all. Spectacular surgery has been emphasized for every ail-

ment. Radium and its products seem to have some mysterious effect in controlling disease. In this prevailing spirit of newness and mysticism, I am hoping Sir Stewart will be joined by a large group of oldsters who will think of glaucoma and other diseases as systemic processes with local manifestations and that without a definite etiology there must be floundering, poor results, and disappointments.

Behold a good lesson has been read unto you by a man of mature judgment, bounded by the principles of common sense. Sir Stewart is advertising no drug, nor is he recommending any operation. He has succeeded in delivering a sermon on the recognition of truthful facts and helping us to analyze a problem. It would be well for all of us to read and re-read "The dependence of surgery on physiology."

(Signed) Louis Lehrfeld,
Philadelphia, Pennsylvania.

CYCLODIALYSIS OR GONIODIALYSIS

Editor,

American Journal of Ophthalmology:

Lee and Allen in their paper, "Cyclodialysis: I. A discussion of techniques," in the AMERICAN JOURNAL OF OPHTHALMOLOGY, December, 1949, page 1713, advocate a combined iridectomy and cyclodialysis as was originally reported by Wootton and later by Wheeler. I am glad to see that they make the scleral incision in such cases only two mm. from the limbus. This is what I suggested in my paper, "Goniodialysis ab externo combined with sclerectomy and iris inclusion," AMERICAN JOURNAL OF OPHTHALMOLOGY, May, 1949, page 634.

I wonder, however, if in making the scleral incision two mm. from the limbus they are producing a goniotomy (goniodialysis) or a true cyclodialysis with separation of the scleral spur. I would suggest that instead of the basal iridectomy, they try an iris inclusion of one pillar and basal iridectomy of the other pillar as I described in my combined operation. Then they will be doing goniotomy ab externo (or possibly cyclodialysis in some cases together with goniotomy) combined with iris inclusion. This combined operation gives excellent control of tension in primary glaucoma and also in congenital glaucoma.

(Signed) Joseph Laval,
New York.

REPLY TO DR. LAVAL

Editor,

American Journal of Ophthalmology:

The communication by Dr. Joseph Laval apparently involves the question as to whether a scleral incision, two mm. back of the limbus, could separate the scleral spur from its attachment (cyclodialysis) or only involves a separation or perforation of the ligamentum pectinatum (goniodialysis).

In making the incision two mm. back of the limbus, the line of reference is the posterior border of the limbus, which can be made out accurately only on exposing it after dissecting the conjunctival flap forward and, if necessary, by using the transillumination method described by Minsky. Thus an incision through the sclera two mm. posterior to the limbus must lie posterior to the attachment of the ciliary body to the scleral spur. A spatula entering the anterior chamber then results in a true cyclodialysis and perhaps, in some cases, a separation of the corneoscleral trabeculas, as well, by the thrust of the cyclodialysis spatula. That a true cyclodialysis is performed has been verified by gonioscopic examinations.

Dr. Laval performs an anterior sclerectomy together with an iris inclusion operation at the same time the goniodialysis is made. One wonders whether the results of the operation are due entirely to the anterior sclerectomy and the iris inclusion rather than in part to the goniodialysis which is performed only over a very small area and is

practically obliterated again by the inclusion of an iris wick through the wound.

In the cyclodialysis operation as practiced by us, a dialysis of about one half the circumference of the ciliary body attachment is made. This increases the opportunity for the maintenance of a filtering cleft.

The scleral incision is made two to three mm. back of the limbus because we feel that manipulation of the cyclodialysis spatula should be confined to the immediate region of the scleral spur. This minimizes trauma to iris, ciliary body, and cornea, and decreases the possibility of hemorrhage into the anterior chamber. Both trauma and hemorrhage will decrease the chances of success of this operation.

A basal iridectomy is not recommended for all cases on which a cyclodialysis operation is performed but only on those with shallow anterior chambers. It serves the double purpose of deepening the anterior chamber and decreasing the opportunity for anterior peripheral synechias to form after the cyclodialysis operation.

(Signed) Otis S. Lee,
Iowa City, Iowa.
and
James H. Allen,
New Orleans, Louisiana.

BOOK REVIEWS

SPECTACLE FITTING AND OPTICAL DISPENSING. By L. S. Sasieni. London, Hammond, Hammond & Co., Ltd., 1950. 294 pages. Price, not listed.

This book is directed principally toward the art of designing custom-made spectacle frames. The author states that this work is intended for students of optical dispensing. If so, those with little or no background will be left with the false impression that all spectacle frames are individually ordered and made from critical specifications given a frame manufacturer.

The author devotes over 100 pages to discussions of numerous and special gadgets used for making detailed measurements of the spectacle frame and the patient's face. None of these rules are commonly used in this country. In describing these devices many illustrations are used. However, the reader finds the text extremely difficult because these illustrations do not show the specific device being used for a specific function. The single exception is found in those pictures illustrating the author's own rule and its use. The American reader may wonder how the British optician finds time to make all of these measurements on the millions of new spectacle wearers which have resulted from Socialized Medicine. Do all of these people get custom-made frames?

The terminology and trade-names used in the text are foreign to American readers. This does, however, add interest to the book and in some instances suggests improvements in our own terminology. For example—the term, "datum line" and its connotation, although infrequently used here, is one we might readily adopt. It certainly would clarify the specifications of axis, optical center, and bifocal segment heights, as well as other notations. The special device used to determine the "datum line," described as the "Empire Datum Rule," is impressive and should prove a valuable aid to all opticians.

The chapter on frame adjusting is illuminating and well illustrated. Much of the material in this chapter is devoted to the bending and adjusting of "saddle" bridge frames, a style not used in this country to any extent in the past 20 years. It is surprising to read a book dated 1950 still devoting space to "saddle" bridge frames.

There is only one chapter devoted to ophthalmic lenses. No attempt is made to discuss them mathematically. Various bifocals are illustrated, most of which are known and used in this country. Failure to refer by name to certain high-quality American bifocals such as Panoptik and Ful-Vue may have been intentional. Only brief mention is made of their design. We doubt whether

many American lenses are used in England because of the low rate of exchange.

The author suggests the adoption of a lens shape numbering system which, unless universally accepted as standard, might create confusion for the optical industry. It does point, however, to the need for a set of standards upon which opticians both here and abroad could agree. We believe that such agreement would be easier of accomplishment with optical manufacturers than with spectacle fitters and dispensers.

The appearance of a new book on this subject is timely in the face of a small revolution in dispensing practice in this country. It could easily serve as an introduction to dispensing and adjusting for many neophytes now being trained as private dispensers. Although parts of the book do create false impressions about practical frame fitting, its main value lies in the emphasis it makes on doing a more careful and critical fitting and designing of the patient's glasses, the purpose of which, as the author states is: (1) To provide the maximum optical efficiency with the lenses prescribed; (2) to provide the maximum comfort with the spectacles; (3) to achieve a pleasing appearance and appropriate style which will overcome any possible antipathy to the glasses.

J. C. Copeland.

PHYSIOLOGY IN DISEASES OF THE HEART AND LUNGS. By Mark D. Altschule. Cambridge, Massachusetts, Harvard University Press, 1949. Price, $5.00.

This is the first edition of a work designed primarily for the research-minded student or practitioner. It is a remarkably complete factual presentation of the current status of experimental work in diseases of the heart and lungs. Little attempt is made to theorize except when it is necessary to interpret conflicting investigative data and conclusions. One gets the impression that a lot of poorly controlled and too eagerly hypothesized experimental work has found its way into medical literature. This is subjected to critical analysis without laborious discussion. The author's own work appears frequently, but this is offset by an extensive bibliography which includes much of the earlier work in the field.

This book leaves the reader with a desire to explore new territory. It also inspires him to submit to proper scientific disciplines in the process. This book not only reviews much of the less recent and too often disregarded scientific work but it also supplies an explanation for many of the puzzling clinical laboratory findings so frequently encountered in medical practice.

Except for one isolated reference regarding the relationship between anoxia, congestive failure, and fusion frequency of flicker, the text contains no pertinent ophthalmic material. In covering its restricted field there is no attempt made to acquire either the continuity or theoretical considerations of a clinical text. Instead it succeeds in its original aim to organize, systematize, and criticize the existing relevant experimental work on heart and lung physiology.

Parker Heath, Jr.

TRANSACTIONS OF THE OPHTHALMOLOGICAL SOCIETY OF AUSTRALIA. British Medical Association, Volume 6, 1946. 155 pages.

In his presidential address, J. Ringland Anderson discusses blindness most thoroughly. In his thoughtful article he not only calls attention to the lesions in the tissues of the eye that lead to blindness but discusses pertinent social and philosophic attitudes of the individual and the community.

P. C. Livingston recounts his experience with night vision in the Royal Air Force and, in a separate article, the clinical and psychologic significance of heterophoria in an aircrew. He points out that, although many men with heterophoria can be taught to fly safely, many fail who later succeed after appropriate orthoptic training.

Diana Mann shows, from an experience of the last five years, what can be expected of orthoptic training. It is valuable for convergence deficiency, heterophoria with symptoms, accommodative squint, divergence excess, and alternating hyperphoria.

There are separate discussions of retrobulbar neuritis, the ocular defects of malnutrition and of blindness in prisoners of war. An observation of angioid streaks and a pedigree of juvenile hereditary retinal detachment are reported.

A survey revealed that of 38 deaf children with a history of maternal rubella, 17 had abnormally pigmented fundi and four had lens opacities.

Arthur D'Ombrain presents a clarification of his earlier suggestion that there is an entity that is appropriately named traumatic monocular chronic glaucoma. It is assumed that slight trauma is enough to start a chronic sclerosing process in the ciliary region or the venous capillary bed which in time results in the progressive ocular edema that is glaucoma. Macindoe discusses the choice of operation in glaucoma.

F. H. Haessler.

LES PROCESSUS ANATOMIQUES DE CICATRISATION DES GREFFES DE CORNEE. By Jean Babel. New York and Basel, S. Karger, 1950. 63 pages, 53 figures. Price, Swiss franc, 8.20.

In a brief introductory statement Babel reviews the history of corneal grafting. The two main sections of the book are devoted to experimental studies of the anatomic process of cicatrization of corneal grafts and histologic studies of human eyes. Each section is introduced by a review of findings published by other workers.

The results of histologic studies of transplanted corneas in the eyes of man and animals are in a large measure concordant. When the graft remains clear, one can be sure of the survival of the lamella and cells of the stroma. The nerves of the transplant, severed from their cell body, degenerate. Their replacement from tissues of the host is not essential to the maintenance of transparency. It does not seem necessary that the graft attains completely usual structure.

When, on the other hand, the graft becomes cloudy after a defective union with thick cicatrization, abnormal vascularization and adhesion of the iris, its structure is greatly altered by the elements that arise in the host. The epithelium, glassy membranes, and stromal lamellae may persist for months and years but fixed cells degenerate and are replaced by cells of the host.

The elements of replacement originate from connective tissue of blood and only exceptionally from the epithelium. So far as these changes are not reactions provoked by the juxtaposition of two tissues, one must postulate unknown chemical factors the elucidation of which may clarify our understanding of the compatibilities of tissues of donor and host on which the success of grafting depends.

The 53 photomicrographs are excellent.

F. H. Haessler.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

1

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Brueckner, R. **Ophthalmoscopic identification of the central area and the fovea in animals.** Ophthalmologica **118**:969-980, Oct.-Nov., 1949.

A number of interesting ophthalmoscopic observations in animals, made partly in vivo and partly shortly after death, are described and recorded on color plates. A definite fovea could be identified ophthalmoscopically and histologically in a four-year-old lioness. Senile degenerative changes were discovered in the macular area of cats.

Peter C. Kronfeld.

De Vincentiis, Mario. **Studies of the embryology and development of the lens in the frog.** Rassegna ital. d'ottal. **18**:217-236, July-Aug., 1949.

The author reviews the experiments of previous investigators employing transplantation and explantation of the ocular area of the embryo. He discusses the theories of the chemical and physicochemical mechanisms of differentiation of certain areas. He demonstrated that complex phenomena precede the formation of the lens and studied the effect of the action of H and OH ions upon the lenticular ectoderm in Ranula esculenta. (6 figures.)

Eugene M. Blake.

2

GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Leplat, G. **Chemical determinations of the cellular reactions in bacterial infections.** Ann. d'ocul. **182**:864-868, Nov., 1949.

The metabolic activity of bacteria, especially of pathogenic ones, partly determines the tissue reactions which result. The exotoxins and endotoxins as well as enzymes produced by bacteria contain polysaccharides and nucleoproteins. The exotoxins are classified as necrotising, hemolytic, and those lethal to specific cells, for example, leucocedine to polynuclear leucocytes. Enzymes may be proteolytic or lipolytic. Following capillary and precapillary dilatation, increased fluid and cells infiltrate the surrounding tissues. In the fluid are alexins, which dis-

solve bacteria and neutralize their activity, as well as trephones, hormones produced by leucocytes, which stimulate fibroblastic activity. In prolonged inflammations, monocytes, histiocytes and fibrocytes play a major part in bacterial destruction, the removal of tissue detritus and recovery. More ascorbic acid is absorbed by histiocytes than by other cells, which may be of importance in the study of connective tissue regeneration. Giant cell formation partly depends upon tissue suboxidation. Chas. A. Bahn.

Turnbull, William. **Effects of experimental retinal anemia in rats.** Arch. Ophth. **43**:9-31, Jan., 1950.

The histologic changes produced in the retina of experimental animals by anemia were studied. After section of the central retinal artery, 1. massive edema immediately occurs in the cerebral layer of the retina; 2. changes in the ganglion cells which are considered irreversible are seen four to five hours afterward, 3. changes in the bipolar cells similar to those in the ganglion cells appear at a slightly later period, 4. there is complete atrophy of the cerebral layer of the retina seven days afterward, 5. the neuroepithelial layer and choroid remain normal, 6. blood reappears in the retinal arteries five hours afterward, first in the vessels at the periphery of the retina and 7. the peripheral retina is affected less than the central retina.

Centrifugation of a rat at plus 10 g for three minutes causes irreversible changes to occur in the retina. The ganglion cell layer is most affected, the bipolar cell layer less, and the nerve fiber layer least. After nitrogen asphyxiation of rats for three minutes there is immediate edema of the retina. Degeneration in the ganglion cell layer, which appears irreversible on histopathologic grounds, occurs in five days. Ralph W. Danielson.

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Bietti, G. B. **Preliminary experimental investigation and clinical observations concerning the effect of paraminosalicylic acid (P.A.S.) on ocular tuberculosis.** Boll. d'ocul. **28**:449-470, Aug., 1949.

In rabbits and in guinea pigs, P.A.S. acts as a bacteriostatic agent; its effect is greater when combined with streptomycin. It is more effective in immune allergic animals, but acts also in others. If administered prior to the experimental infection, neither P.A.S. nor streptomycin prevent the disease. The involvement of the eyes, however, was much milder in comparison with eyes of previously untreated animals. Interruption of the treatment was followed by recurrence. P.A.S. and streptomycin alone or together do not sterilize the diseased tissue; if the animal, however, has developed stronger resistance after a previous infection, complete healing occurs in some instances. P.A.S. alone or together with streptomycin was administered to 18 patients with tuberculous keratitis, anterior or posterior uveitis, retinal periphlebitis or papilloretinitis. A comprehensive table demonstrates good results but Bietti prefers to suspend judgment until more experience becomes available. The dosage was 10 to 15 grams daily for 20 days followed by 10 days without P.A.S. before a new course was given. Streptomycin was administered in daily doses of 0.5 grams. (10 figures, references.) K. W. Ascher.

Hamburger, F. A. **Recent work in the physiology of the retina and its significance for ophthalmology.** Klin. Monatsbl. f. Augenh. **115**:112-119, 1949.

Study of photo-chemical reactions in the retina reveal that the intensity of a light sensation depends on the amount of

incoming light energy as well as on the degree of chemical reactions within the retinal sensory epithelium. Increase in visual purple and other photochemical visual properties increases the light sensation, while a decrease lowers it. Overfeeding with vitamin A and similar substances leads to such an increase of visual purple. Photochemical reactions are also dependent on the amount of oxygen which is supplied by the choroid. This varies with the blood supply within the choroidal vessels. A reflex hyperemia of these structures elicited by dark adaptation and asthenopia is conceivable and may increase the supply of oxygen for photochemical processes. Sudden local adaptation and tiring of the retina bring about symptoms and objective findings of asthenopia, like tearing and redness of the conjunctiva in many patients. (References.) Max Hirschfelder.

Morone, G., and Nižetic, B. Z. **The action of P-like substances on the blood-aqueous barrier in experimental scurvy.** Boll. d'ocul. **28**:403-409, July, 1949.

The permeability of the blood-aqueous barrier of normal guinea pigs was ascertained before changing their diet to Beszonoff's scorbutigenic C- and P-free cereal-yeast-egg mixture. The fluorescein transfer from the blood into the anterior chamber was measured according to the Amsler-Huber method 20, 24, and 27 days after changing to the deficiency diet, and four days after treatment of the diseased animals with methyl esculetol; 25 milligram of bisodium salt of the disulphuric ester of 4-methyl-esculetol were injected hypodermically per 400-gram guinea pig. In normal animals it took 10 minutes before the dye appeared in the anterior chamber; gradually less time elapsed between injection and coloration of the aqueous with the advance of the experimental scurvy. On the 27th day the dye was found one or two minutes after administration. Return to normal values was achieved after four days of vitamin treatment. K. W. Ascher.

Rosen, L. **Pantothenic acid in ophthalmology.** Ophthalmologica **118**:940-944, Oct.-Nov., 1949.

The author reports beneficial results obtained by local application of pantothenic acid (5 to 10 percent in ointment) in corneal ulcers and certain forms of dermatitis. Pantothenic acid is a member of the vitamin B complex and is essential for rats, possibly also for man.

Peter C. Kronfeld.

Von Sallmann, L., and Dillon, B. **Problem of effect of radioactive indicators used in physiologic studies on the eye.** Wien. klin. Wchnschr. **61**:714-716, Oct. 21, 1949.

The irradiated eyes of rabbits showed a definite increase in the diffusion of fluorescein into the anterior chamber as compared to the control eyes, provided that the roentgen dose employed was 250 r or more. Theodore M. Shapira.

Toselli, Carlo. **The influence of skeletal muscular activity upon the duration of voluntary deviations of fixation.** Rassegna ital. d'ottal. **18**:264-275, July-Aug., 1949.

The author determined by experiment that the ocular muscles react as other skeletal muscle groups, in the sense that their activity, expressed by the maximum duration of voluntary deviation of fixation, is sensibly improved by preceding muscular work of another group of muscles, such as those of the fingers. This behavior is noted not only in orthophoric individuals, but also in concomitant and paralytic strabismus. The cause of the phenomena observed is probably of nervous origin, and there may be a vasomotor factor. Numerous protocols are included to demonstrate the thesis.

Eugene M. Blake.

Zwiauer, A., and Bornschein, H. **Pharmacologic action upon the choroidal blood-vessels.** Arch. f. Ophth. **149**:407-412, 1949.

Rabbits were used and the vessels of their fundi were studied 25 times magnified with the help of a microscope and a contact-lens. Systemic administration of small doses of adrenalin, vasopressin, nitroglycerine and amylnitrate did not change the diameters of the choroidal vessels, while the retinal vessels were affected as expected. Ernst Schmerl.

Zwiauer, A. **Function of the choroid.** Wien. klin. Wchnschr. **61**:724-725, Oct. 21, 1949.

The vessels of the choroid were studied in the fundus of albino rabbits, with the aid of a special microscope, while various pharmacologic preparations were administered and variations were produced in the intraocular pressure which provided a magnification. The vessels of the choroid showed no spontaneous caliber changes even during prolonged observation, whereas the retinal vessels showed spontaneous caliber fluctuations that were independent of pulsation. In order to obtain information about the rapidity of the passage of blood through the rabbit eye, a solution of methylene blue was injected into the vein of the ear. In 7 to 9 seconds the entire fundus was blue, and from 10 to 12 seconds later the color was normal again. Even after rather high doses of adrenalin no changes occurred in the choroidal vessels, but the fact that the entrance of the dye-stuff was retarded indicates increased resistance in the extraocular vessels. In contrast, the retinal vessels responded with definite constriction. Vasodilator drugs also exerted no definite effect on the vessels of the choroid, whereas the retinal vessels responded with a noticeable dilation.

Changes were induced in the intraocular pressure; even with pressures of 100 or 120 mm. Hg there was still some circulation in the choroid vessels, whereas the retinal vessels were no longer permeable with this pressure.

Theodore M. Shapira.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Arndt, Gerhard. **Differences between various charts for testing visual acuity.** Klin. Monatsbl. f. Augenh. **115**:157-161, 1949.

In comparing the results of testing visual acuity with five different charts it was found that they lacked uniformity. Letters were better recognized than numbers. The letter size varied for the same acuity in various charts, giving rise to errors. The author proposes a chart which has uniform values for breadth and length of letters, most careful printing, and fulfills the requirements of the Snellen principle as to visual angle. Certain letters and numbers which are easily read are to be avoided. Max Hirschfelder.

Best, F. **The examination of stereoscopic vision.** Arch. f. Ophth. **149**:413-430, 1949.

An apparatus is described based upon Hering's three-rod-method. Testing for binocular depth perception is not a necessary routine examination.

Ernst Schmerl.

van Beuningen, E. G. A. **The experimental and statistical biological conditions necessary for the determination of changing efficiency in dark adaptation.** Arch. f. Ophth. **149**:490-502, 1949.

Determinations of dark adaptation with and without the administration of drugs serve to illustrate that well-defined experimental as well as mathematical methods are necessary for the correct evaluation of empirical data.

Ernst Schmerl.

Campus, Evaldo. **Daltonism.** Rev. brasil. oftal. **7**:175-214 June, 1949; **8**:3-27 Sept., 1949; and **8**:79-111, Dec., 1949.

The subject is reviewed (in Portuguese) under the following headings: light; the luminous spectrum; theories of color vision; color vision in the animal series and in children; diagnostic methods; forms of transmission and incidence; daltonism in practical life; visual field; blood type; chromatopsia; and treatment. No new conclusions are presented. (27 pages of bibliography.) W. H. Crisp.

Katz, Joachim. **Accommodation and convergence.** Klin. Monatsbl. f. Augenh. **115**:134-136, 1949.

Katz discusses mathematically the physical-optical relations between the distance of object and accommodation. A distance of 5 meters from the test chart is sufficient to exclude accommodative efforts, if the pupil is 3 mm. wide. For a pupil 4 mm. in width this distance would have to be 10 meters. Larger distances are not needed, unless one wants to abolish all effort of convergence. Convergence at 200 meter is 1′11″, at 5 meter it is 46′48″ and at 25 cm. it is 15°29′22″ or 785 times as much as at 200 meters (figured for 68 mm. pupillary distance).

Max Hirschfelder.

Littmann, H. **The relaxation of accommodation by optic methods.** Klin. Monatsbl. f. Augenh. **115**:136-142, 1949.

Optic methods make it possible to relax the active accommodation, while latent accommodation and normal width of the pupil remain undisturbed. Observation of a distant object by the fellow eye as well as the photoscope of Pascal which offers a distant point of fixation to the eye by means of a fixed lens system (collimator) and a 45-degree plane mirror are useful in emmetropic and myopic, but inaccurate in hyperopic patients. The author devised an instrument which has a movable target between the illuminating source and collimator objective. A glass plate offers this target to the eye of the patient as a mirror image. By varying the distance of the movable target in relation to its position from the collimator lens system various "distant" points can be chosen. Positions can be selected which lie beyond the punctum remotum, a means to relax the accommodation in an hypermetropic eye. The optimum relative position between collimator and punctum remotum was found to be +2 diopters. (4 figures, references.)

Max Hirschfelder.

Pau, Hans. **Lenticular changes in axial myopia and in old age.** Arch. f. Ophth. **149**:431-436, 1949.

Sixty cases are studied. The author finds increasing size and sclerosis of the lens nucleus more often in higher myopia, while cortical changes occurring later in life do not show any correlation to the degree of nearsightedness.

Ernst Schmerl.

Tschermak-Seysenegg, A., and Heinsius, E. **Test chart with luminous colors for test of night vision.** Klin. Monatsbl. f. Augenh. **115**:120-125, 1949.

The authors propose the use of luminous colors which are activated by ultra-violet light for a test of night vision. The peculiarities of night vision with preponderance of different wave lengths and relative central scotoma are considered in the arrangement of the charts. The charts show a dark Snellen hook or Landolt ring within a bright circle and permit the turning of the figure in a definite direction. The charts can also be used for training of night vision. (1 figure, references.)

Max Hirschfelder.

Wagner, Eberhard. **The Pulfrich effect.** Klin. Monatsbl. f. Augenh. **115**:143-149, 1949.

The Pulfrich effect describes the perception of depth, whenever two eyes observe a swinging pendulum and the illumination is cut down by filters in front of one of them. The pendulum which actually swings in a plane will be seen swinging in an elipse. The author found that external influences on the psyche of the patient on different days did not change the intensity of the phenomenon, whereas the pseudo-excursions of the pendulum become larger whenever the test person became tired. The size of the elliptic course decreased with increase of the illumination. The seemingly larger excursions in the back of the swinging plane are explained by functional characteristics of the visual organ. (1 figure, references.)

Max Hirschfelder.

5

DIAGNOSIS AND THERAPY

van Beuningen, E. G. A. **Changes of sensory efficiency due to exercise; their role in clinical examinations.** Arch. f. Ophth. **149**:460-489, 1949.

The role of exercise was studied by repeated examinations of depth perception and light adaptation in a large number of persons. These studies showed that a method testing for sensory efficiency should meet these requirements. The curve of the average values obtained by testing a large number of persons should not surpass 25 percent of the primary values. After 4 to 5 days of practicing no major deviations from the average values should occur and no further improvement of the sensory efficiency should be detectable. As instruments for the testing of the depth perception the author recommends Monjé's stereoeidometer and Helmholtz' three-rod apparatus. For testing light adaptation the Auer radiumadaptometer and the Novak-Wetthauer adaptometer proved to be satisfactory.

Ernst Schmerl.

Engelbrecht, Kurt. **A home-made lantern test for checking of red-green sensitivity.** Klin. Monatsbl. f. Augenh. **115**: 125-127, 1949.

The opening of a lamp used for indirect ophthalmoscopy is closed down to 1 mm.^{2} Lenses of various colors are arranged in a skioscopy rack. A small sliding frame containing smoked lenses and opaque lenses runs along the rack and each color can be tuned down to simulate fog or smoke. By holding this rack in front of the small lamp opening, reliable tests of red-green sensitivity, as they are needed in railroad workers, may be obtained. (3 figures.)

Max Hirschfelder.

Grignolo, Antonio. **The localizing value of some ocular symptoms in suprachiasmatic lesions.** Riv. oto-neuro-oftal. **24**:310-321, July-Aug., 1949.

Of great importance are perimetric and campimetric fields, pupillary signs, disturbances of extrinsic ocular motility, and ophthalmoscopic signs. A great deal of information is summarized in tabular form.

Melchior Lombardo.

Howard, W. H. **New foreign body instruments and their use.** Arch. Ophth. **43**:92-95, Jan., 1950.

This description of instruments and technique should be read in full. Use of the slit-lamp is urged. One paragraph is to this reviewer worthy of quotation. "In cases of central foreign body the deepest portion of the rust-stained cavity is occasionally too tenacious to permit a safe removal. Here, caution may advise the removal only of the major part of the rust stain, the deepest portion, which is only fragmentary, being allowed to soften and separate. This will require 24 hours, at which time it will be seen that the stained area has moved slightly forward and is more accessible, and in removal re-

quires less trauma to the immediate posterior tissue."

Ralph W. Danielson.

Schober, Herbert. **A new white and color campimeter with a screen marked for use in squint.** Klin. Monatsbl. f. Augenh. **115**:149-157, 1949.

White and colored test marks are projected by an electric hand illuminator. The screen is of gray metal. One side is used for campimeter measurements, the other side bears tangent scale markings for measurement of angle of squint. The projecting instrument is characterized by a uniform and sufficiently strong intensity of light, by invariably true colors and by its easy use. (4 figures, references.)

Max Hirschfelder.

6

OCULAR MOTILITY

Giardini, A. **Voluntary nystagmus.** Riv. oto-neuro-oftal. **24**:245-266, May-June, 1949.

Horizontal pendular voluntary nystagmus was observed in a healthy physician of 34 years. The nystagmus and the condition under which it could be brought forth are described in detail. Other members of the family could provoke the same movements. The differential diagnosis between the voluntary and other types of nystagmus and of simulation are discussed. (References.)

Melchior Lombardo

Giotta, P. J. **Differential diagnosis of pareses of superior oblique and superior rectus muscles.** Arch. Ophth. **43**: 1-8, Jan. 1950.

The differential diagnosis of pareses of the superior rectus and superior oblique muscles in cases of vertical muscle imbalance with head tilt and full binocular vision is discussed. Six illustrative cases are presented. The consistent secondary and primary deviations noted are of definitive importance in showing that the natural head tilt and the findings in the head tilt test are due to weakness of the superior oblique muscle, and not to overaction of the inferior oblique muscle in the same eye secondary to an initial paresis of the contralateral superior rectus muscle. A convenient method of performing the head tilt test is by use of hand stereoscope. Two cards may be used to separate the vertical and the torsional deviations. Ralph W. Danielson.

Ohm, Johannes. **The action of vertically acting ocular muscles.** Klin. Monatsbl. f. Augenh. **115**:128-134, 1949.

A special way of mapping double images on a tangent screen devised by the author is described. The recti act as pure elevators in a plane at an angle of 45 degrees to the vertical. No typical influence of the elevators upon the lateral rotations of the eyes was found. The mechanism of torsional movements of the bulbi is discussed. (5 figures, references.)

Max Hirschfelder.

Ohm, J. **Dissociated innervations of the ocular muscles.** Arch. f. Ophth. **149**:364-396, 1949.

The author refers to many of his former studies of ocular motility and the vestibular apparatus. This report does not lend itself to abstracting. Ernst Schmerl.

Zazalia, A. U. **Disturbances of the vertical ocular muscles.** Arch. y. mem. de la soc. de oftal. del Litoral **1**:1-41, 1947-1948.

After a detailed discussion on the physiology and pathology of the vertical muscles the author summarizes his experience in the examination of their function and disorders. He classifies the anomalies in four groups, namely, concomitant deviations, acquired paralysis, unilateral or bilateral congenital insufficiences and the

alternating hyperphoria and hypertropia. The concomitant vertical deviations are very rare and might not even exist at all. An acquired paresis of any elevator or depressor muscle might be the cause for the development of any convergent concomitant squint except the pure accommodative variety. For the alternating hyperphorias the author accepts the explanations given by Bielschowsky.

Alice R. Deutsch.

7

CONJUNCTIVA, CORNEA, SCLERA

Bottasso, Giovanni. **The histo-pathology of conjunctival localizations in erythema multiforme.** Rassegna ital. d'ottal. **18**:276-284, July-Aug., 1949.

Involvement of the conjunctiva is quite rare in erythema multiforme and in only one previous case has there been a histologic report. Bottasso's patient was a housewife, 49 years of age, who had had recurrent attacks of the skin lesion each spring for six years. The conjunctival lesion consisted of a rounded, elevated nodule on the nasal side of the bulbar conjunctiva of each eye. The nodules were reddish in color with pale center, firm, painless and surrounded by hyperemia. Eosinophiles were abundant in the secretion. Histologically there was seen thickened epithelium with a few areas of desquamation, and lymphocytic infiltration. Healing was complete in 20 days. (4 figures.) Eugene M. Blake.

Colombi, Carlo. **Two cases of hypopyon ulcer treated successfully by injection of penicillin into the anterior chamber.** Rassegna ital. d'ottal. **18**:250-251, July-Aug., 1949.

Two patients with severe corneal ulceration due to trauma and with iris synechias and hypopyon were first given sulphonamides, atropine and local antiseptics without benefit. They were then given 500 O.U. of penicillin into the anterior chamber after withdrawing .15 cc. of aqueous. In addition 25,000 units were injected subconjunctivally. The results were excellent in both instances.

Eugene M. Blake.

Corréard, R., and Plessier, P. **Recent epidemic of keratoconjunctivitis in the Paris district.** Ann. d'ocul. **182**:859-863, Nov., 1949.

The epidemic observed in Paris was apparently due to the virus of Sanders and closely resembled similar epidemics which occurred in the United States during World War II characterized by nonpurulent conjunctivitis with chemosis, conjunctival follicles and glandular enlargement, and sub-epithelial punctate keratitis. The incubation period was apparently 5 to 10 days. Penicillin and the sulfonamides were without value except in some secondary infections. The course of the disease was apparently shortened by the use of convalescent serum in 50-cc. intramuscular injections, which should be employed before the fifth day.

Chas. A. Bahn.

Franceschetti, A., and Bischler, V. **The prognosis in keratoplasty.** Ophthalmologica **118**:909-923, Oct.-Nov., 1949.

This report is based on 120 human eyes on which keratoplasties after the method of Franceschetti had been performed for visual purposes. The data were tabulated according to the underlying corneal disease and the final degree of transparency of the graft. A definite correlation between the original corneal disease and the result of the keratoplasty was found. The prognosis is favorable in most, if not all corneal dystrophies, in phlyctenular keratitis and in corneal opacities due to congenital or infantile glaucoma. In almost all cases in this very favorable group a permanently clear graft was obtained if the transplantation was repeated when the first graft became cloudy. Severe

chemical burns, severe corneal injuries and corneal degenerations in aphakic eyes made up the most unfavorable group. In the many remaining types of corneal disease the chances of obtaining a clear graft proved to be about 50 percent. The prognosis depends primarily on the nature of the territory into which the graft is implanted. Absence of the anterior chamber and contact with the vitreous body are unfavorable factors. Peter C. Kronfeld.

Purtscher, E. **The origin of the white corneal rings.** Arch. f. Ophth. **149**:397-406, 1949.

Four observations are reported which demonstrate that Coats's white rings of the cornea are of traumatic origin. The importance of this causative factor in medico-legal cases is emphasized.

Ernst Schmerl.

Schmoeger, Elisabeth. **A case of severe pterygium.** Klin. Monatsbl. f. Augenh. **115**:161-164, 1949.

A 54-year-old woman had bilateral nasal and temporal pterygium which almost reached the corneal centers. Such an advanced appearance is very rare. (2 figures, references.)

Max Hirschfelder.

Schwab, F. **Fate of eyes after keratitis eczematosa: follow-up studies on 100 cases.** Wien. klin. Wchnschr. **61**:719-722, Oct. 21, 1949.

In only 3 of the 100 patients who had scrofulosis or keratitis eczematosa did true tuberculous processes develop in the eye in later life; one woman had a bilateral scleritis with sclerotizing keratitis and two men a unilateral choroiditis.

Theodore M. Shapira.

Sourdille, G. P. **The late effects of yperite on the cornea. Treatment of yperite keratitis by conjunctoplasty.** Ophthalmologica **118**:893-908, Oct.-Nov., 1949.

Thirteen cases of late keratitis due to yperite (mustard gas) burns sustained during the first World War are reported. The course and the clinical picture of the disease are usually very characteristic. After a latent period which may last several years, the disease starts with mild episodes of tearing and photophobia which are usually labelled as conjunctivitis. These spells become more frequent and more severe until they coalesce into a more chronic disease characterized by surface irregularities and small circumscribed deep infiltration of the cornea, associated with circulatory disturbances in the adjacent conjunctiva. All lesions are characteristically located in the portions of cornea and conjunctiva exposed in the palpebral fissure.

The writer attaches great significance to the conjunctival changes which he describes as narrowing of the arteries, venous stasis, venous varicosities and circumscribed gelatinous edema of the conjunctival stroma. Although the cornea is markedly hypesthetic, there usually is intense photophobia. The small corneal infiltrations may coalesce into large "polycyclic" opacities. In the later stages the subjective symptoms of inflammation become less pronounced. Eyes with late yperite keratitis are very susceptible to secondary bacterial infection. Histologic examination by G. Offret of pieces of resected conjunctiva revealed sclerosis of the vessel walls as well as of the conjunctival stroma. Sourdille considers these conjunctival changes as the main factor in the pathogenesis of the keratitis. Replacement of the sclerosed conjunctiva by sliding conjunctival flaps or free grafts from the upper fornix has proved to be very effective treatment.

Peter C. Kronfeld.

9

GLAUCOMA AND OCULAR TENSION

Lowenstein, Otto. **The central-nervous factors in the genesis of acute simple**

glaucoma: results of experimental pupillographic studies. Monatschr. f. Psychiat. u. Neurol. **117**:294-306, April-May-June, 1949.

With a specially designed cinema-camera, which takes 10-20-50-100 pictures per second, the author photographed in a dark room the pupillary movements of both eyes simultaneously on a very sensitive Kodak-infrared film. From the developed film a specially constructed photoelectric-oscilloscope automatically registers the width and narrowness of the pupil. The time is registered on the abscissa and the width of the pupil on the ordinate.

After a light stimulus of one second duration the pupil begins to react after a latent period of 0.18 to 0.22 seconds. Its contraction can be divided into three phases which together last 0.45 seconds. After the lapse of one second, at the end of the light stimulus the pupil dilates. The dilatation can be divided into three phases. The primary contraction phase, the second and third dilatation phases are of parasympathetic origin, the primary dilatation, the second and third contraction phases are of sympathetic origin.

If the eye is successively stimulated at intervals of four seconds, the pupil becomes exhausted after a comparatively short period. It is unable to contract to further light stimuli. If we now interject between two light stimuli a sensory stimulus, such as touch, pain, or sound the pupil will react again to light. This is called the psychosensory restitution phenomenon. Analysis of the pupillograms will disclose the origin of the pupillary disturbance, whether it is of sympathetic or parasympathetic, central or peripheral origin. If there is somewhere in the body a sympathetic disturbance it must register in the pupillary reaction if the disturbance is of central origin.

Pupillographic studies proved that central sympathetic, probably hypothalamic, disturbances are the forerunner of increased intracranial tension. Patients with unilateral simple glaucoma and an apparently normal second eye were examined. Pupillary disturbances were without exception present in both eyes and were usually of equal magnitude. Occasionally the healthy eye showed greater disturbances than the afflicted eye. While the primary phase was normal, the second and third contraction phases, which are of sympathetic origin, became shorter or disappeared entirely. Furthermore, the secondary dilatation phase disappears in glaucoma. Similarly, the psychosensory restitution phenomenon is absent in primary simple glaucoma. R. Grunfeld.

Stone, W. C. **Use of di-isopropyl fluorophosphate in treatment of glaucoma.** Arch. Ophth. **43**:36-42, Jan., 1950.

Di-isopropyl fluorophosphate (DFP), used in 150 glaucomatous eyes in the Eye Institute in New York, controlled the intraocular tension in 90, or 60 percent, over varying periods of observations when previous miotic or surgical therapy had failed. A 0.2-percent solution of the drug was used in all cases. The types of glaucoma which were benefited by the treatment were chronic and acute exacerbations of noncongestive glaucoma, chronic and acute congestive glaucoma and secondary glaucoma of various types, especially aphakic glaucoma. It was possible in 31 eyes to return to the former miotic therapy after instillation of di-isopropyl fluorophosphate. Rise in intraocular pressure was observed in 24, or 16 percent, of all eyes treated. In 17 of these eyes this rise developed after the tension had been controlled for short periods. A second disadvantage of di-isopropyl fluorophosphate therapy, the pain due to ciliary spasm, gradually decreased after a few days of treatment. Ralph W. Danielson.

Weekers, L., and Weekers, R. **The treatment of buphthalmus.** Ann. d'ocul. **182**:869-879, Nov., 1949.

After a brief outline of the extraocular and miotic treatment of buphthalmus, its surgical treatment is discussed in detail. The authors favor iridencleisis and claim normalization of tension in 96 percent of cases. Nonperforating cyclodiathermy is also considered favorably. It had normalized tension in 68 percent of a series of cases. The authors consider glaucoma a secondary complication.

Chas. A. Bahn.

10

CRYSTALLINE LENS

Atkinson, W. S. **Flakes of iris pigment on posterior surface of cornea following cataract extraction.** Arch. Ophth. **43**:32-35, Jan., 1950.

Large flakes of pigment dislodged during intracapsular cataract extraction may seriously affect the vision. Trauma dislodges the flakes of pigment, and in the diabetic patient less trauma is required than in the normal. The pigment which appears in the anterior chamber during and after delivery of the lens can usually be removed by irrigation. If it is not completely removed at the time of operation, its position may change as the anterior chamber reforms. Proliferation of the pigment greatly reduces vision. Impairment of vision or irritation of the cornea by the pigment flake may be sufficient to make postoperative removal advisable.

Ralph W. Danielson.

Fontana, Francesco. **The operative problem of secondary (membranous) cataract.** Rassegna ital. d'ottal. **18**:237-249, July-Aug., 1949.

The etiology and development of membranous cataract following extracapsular extraction is fully considered and its prevention, so far as possible, is outlined. All of the numerous surgical procedures for the opening or removal of the membrane are discussed. The author stresses the need of careful study of the cataractous eye before operation and for skillful technique at the time of extraction. He concludes that most surgeons prefer the Graefe discission, except in cases with dense central membrane without iris adhesions when the membrane may be removed by forceps. Dense iridocapsular membranes are best dealt with by using a capsule punch. Eugene M. Blake.

Vannas, Mauno. **The intracapsular cataract operation—experiences and suggestions.** Ophthalmologica **118**:866-878, Oct.-Nov., 1949.

Vannas discusses procedures pertaining to the technique of the intracapsular cataract operation which he introduced at the Eye Clinic of the University of Helsingfors and which have stood the test of at least five years' continuous use. The "retrobulbar" injection of procaine is made half-retrobulbarly over the superior rectus. Another injection of procaine is made between the caruncle and the medial rectus. The lens capsule is grasped just anterior to the upper equator. The lens is thus extended, when being extracted, into an egg-like shape, and can be pulled out of a wound even smaller than two-fifths of the circumference. By applying a concentrated epinephrine solution (glaucosan) directly to the upper sector of the iris an extreme degree of eccentric mydriasis is produced which exposes the portion of the capsule to be grasped. If the sphincter of the iris is unusually rigid, it is secured by means of a silk suture and placed into the corneal incision. During the delivery of the lens the surgeon manipulates the capsule forceps and, by means of the corneoscleral suture, the anterior wound lip. By means of silk-covered cotton applicators (which are introduced

into the anterior chamber) the assistant keeps the wound dry and the iris in a state of pseudocoloboma; with his other hand he expresses the lens with an externally applied strabismus hook. Immediately after the delivery the strabismus hook is used to close the wound and keep it closed until the suture is tied. The latter is preplaced and essentially of the Liégard type. The corneal bite is taken first. The scleral bite is very much longer and interrupted in the middle by bringing the suture ends out of the sclera and through the conjunctiva just nasally and temporally of the vertical meridian. The knot lies externally just over the central break in the scleral bite. The suture is removed on the eighth postoperative day. The operation is apparently "flapless."

Peter C. Kronfeld.

11

RETINA AND VITREOUS

Brognoli, C. **Unusual development of the fundus changes in brother and sister suffering from macular degeneration.** Boll. d'ocul. **28**:410-423, July, 1949.

Brother and sister, children of first cousins, were described by Caocci (Boll. d'ocul. 14:5, 1935). At that time both showed innumerable yellow dots of different sizes grouped in incomplete circles around the macular regions and also nasally from the discs. Visual acuity was poor and still worse in bright light. Twelve years later the yellow dots had disappeared and atypical retinosis pigmentosa was present in all four eyes. (4 fundus colored drawings, 35 references.)

K. W. Ascher.

Fedrizzi, Giuseppe. **The treatment of retinitis pigmentosa with injections of nicotinic acid near the optic foramen.** Rassegna ital. d'ottal. **18**:252-263, July-Aug., 1949.

Forty-six cases of pigmentary degeneration of the retina were treated, partly by intravenous injection and partly by retrobulbar injection of nicotinic acid (nicotene gr. 0.03). The various drugs and procedures which have been tried at one time or another are described.

Twenty-four patients were given the nicotinic acid by vein and in six there was definite dilatation of retinal vessels and an average increase in vision of 2/10. In 8 of 23 cases the deep orbital injection led to improvement while in 17 the results were doubtful or negative. Symptomatic but temporary improvement appeared to be fairly common. The greatest gain in chorioretinal circulation and increase of central vision occurred in the early stages of the disease and one could expect little or no help in old cases with extensive pigment change.

Eugene M. Blake.

Giardini, A. **Bearing of vascular and hematologic factors on diabetic retinopathy.** Boll. d'ocul. **28**:385-402, July, 1949.

In a study on 58 diabetic patients, 36 of whom had diabetic retinopathy, the Goethlin test revealed increased capillary fragility in 8 out of 9 patients with retinopathy. Blood pressure and renal function were not decisive. Increased capillary fragility was of great prognostic significance in some patients with normal retinas; they developed retinopathy later while others with normal Goethlin index did not. The fragility index was roughly proportional to the severity of the retinal changes and to the duration of the disease. Blood protein readings and the albumin-globulin ratio did not differ in patients with and without retinopathy. Together with Rosso and Siliprandi, the author studied the retinas of rabbits rendered "diabetic" by alloxan intoxication; these animals did not have any retinal hemorrhages, even after partial substitution of blood plasma by Locke's solution. (2 tables, 44 references.)

K. W. Ascher.

Giraud, M. G. **The headaches of solitary cerebroretinal hypertension.** Schweiz. med. Wchnschr. **70**:884-887, Sept. 24, 1949.

Isolated hypertension of the retinal arteries combined with headache in the absence of general hypertension is not a rare occurrence. Sometimes the retinal hypertension is but the forerunner of a general hypertension, arteriosclerosis, or cerebral tumor. At other times the hypertension is due to localized sympathetic disturbance or it is associated with a general metabolic or neurovegetative disorder. Although its prognosis is not grave, it demands a careful clinical investigation and observation.

R. Grunfeld

Malamud, Boris. **Results observed in various eye affections by treatment with melanophoric hormone.** Semana Méd. **56**: 1176-1180, Dec. 29, 1949.

The author worked along the lines followed by Mussio Fournier (Bull Acad. de Médic, Paris, 1949) using extracts of the intermediate and posterior lobes of the hypophysis, in 74 cases of diabetic and hypertensive retinopathy, senile macular degeneration and retinitis pigmentosa. Temporary improvements were obtained in visual acuity and hemeralopia, but no anatomic improvement. (References.) W. H. Crisp.

Quiroz, J. A., and Iturbe, I. **The ocular fundus in diabetes mellitus.** An. Soc. mex. de oftal. **23**:1-18, Jan.-March, 1949.

The author discusses whether such changes in the diabetic are characteristic of the disease or merely incidental. He arrives at the conclusions that there may exist a certain relation between the proportion of cholesterol in the blood and the incidence of diabetic retinitis; that there is a frank relation between the age of the disease and the incidence of diabetic retinitis; and that the general treatment appears not to influence the incidence of the retinal changes. (5 graphs, references.) W. H. Crisp.

Rados, Andrew. **Hemangioblastoma of the retina.** Arch. Ophth. **43**:43-65, Jan., 1950.

This paper consists of a thorough review of the literature on the clinical appearance of the disease, two case reports and numerous photomicrographs.

Ralph W. Danielson.

12

OPTIC NERVE AND CHIASM

Loehlein, W., and Toennis, W. **Surgery of tumors of the optic nerve in the optic foramen.** Arch. f. Ophth. **149**:318-354, 1949.

Twelve cases are reported in children between 3 and 13 years of age. In a first step the intracranial part of the tumor was removed just in front of the chiasm. An opening was made into the roof of the optic channel, the intracanalicular part of the optic nerve was mobilized and the ophthalmic artery was closed. About two weeks later the eyeball, the orbital and the intracanalicular part of the optic nerve and the tumor were removed. Exenteration and Kroenlein's operation were avoided. Eleven of the patients stood both procedures very well. All wounds healed by first intention. Removal of the tumor was incomplete in two patients, four could not be followed, and the other five did not show any complications for periods of from one and one half to six years. One of the tumors which clinically was considered as a glioma turned out to be a tuberculoma. X-ray pictures had shown the optic channel as much enlarged as in true tumors. Ernst Schmerl.

Monbrun, A., and Potier, R. **Complete blindness following the prophylactic use of quinine in a child two and half years old.** Arch. d'opht. **9**:592-595, 1949.

A child of two and a half years was given preventive doses of quinine on his arrival at Brazzaville in French Equatorial Africa. Two weeks later he suffered an epileptiform attack associated with dilated pupils and bilateral complete blindness with total loss of the light reflex. Malaria developed in spite of the quinine therapy. Vision slowly returned and two months later the acuity and fields were normal although the discs were still slightly pale and the vessels contracted. Therapy consisted principally of vasodilators and vitamin B_1. The malaria was treated with atabrine, nivaquine, and paludrine. The authors conclude that the attack was characteristic of quinine toxicity. Phillips Thygeson.

Renard, G., David, M., and Brégeat, P. **Acute edematous intracanalicular optic neuritis.** Arch. d'opht. **9**:584-591, 1949.

The authors describe a type of optic neuritis with acute edema in the optic canal which results in strangulation of the nerve unless relieved rapidly by surgery. Young adults in good health are most often afflicted and there are no prodromal symptoms. The attack is characterized by a sudden drop in acuity with the development of an absolute scotoma varying from 5 to 10 degrees. The acuity may drop to zero. The disc may show a slight edema of the border which tends to increase if not relieved. Later varying degrees of atrophy supervene in untreated cases. There is no local pain or any accompanying headache or other neurological sign. The second eye frequently becomes involved but only after a latent period of from three weeks to three and a half months. Transfrontal exploration shows an optic nerve markedly increased in volume and generally ecchymotic and of an abnormal violet-shaded color. There seems to be little or no involvement of the chiasm and no arachnoiditis. Surgical intervention, consisting in unroofing the canals, is almost always successful if practiced early in the disease. Three cases are reported in detail with drawings to illustrate the steps in the surgical treatment. Phillips Thygeson.

13

NEURO-OPHTHALMOLOGY

Alpers, B. J., and Schlezinger, N. S. **Aneurysm of the posterior communicating artery.** Arch. Ophth. **42**:353-364, Oct., 1949.

Isolated aneurysm of the posterior communicating artery is not excessively rare as is attested by the author's presentation of seven proven cases. The clinical history of recurrent headache associated with the development of ophthalmoplegia involving the third nerve appears to be the most significant feature in the diagnosis. There is little else which has been found to be helpful, except for the arteriogram, but in almost all cases this procedure is unnecessary. Seven cases are reported in detail. In four of six cases the surgical ligation and excision of the aneurysm was successful. In the seventh case death occurred before operation could be accomplished.

John C. Long.

Bryson, J. G. **Ocular manifestations of intracranial injury.** Military Surg. **104**: 348-357, May, 1949.

In order to help in establishing a more accurate diagnosis and prognosis, the author has provided a brief résumé of neuro-ophthalmology and a table differentiating papilledema from papillitis. Where optic atrophy has been out of proportion with the extent of the head injury, the damage may often be ascribed to an increase in the virulence of a pre-existing lues, tuberculosis, malaria, hypertension, or septic foci. Francis M. Craig.

Carreras Matas, B. **False retrobulbar neuritis.** Arch. Soc. oftal. hispano-am. **9**:736-744, July, 1949.

A man, 36 years of age, presented himself with a unilateral central scotoma, which improved somewhat under therapy for retrobulbar neuritis. In the further course of the disease the development of homonymous hemianopsia gave a clue to the pathologic process, and X-ray study led to the diagnosis of a chromophobe adenoma of the hypophysis. X-ray therapy resulted in the disappearance of the scotoma, normal visual fields, and recovery of visual acuity. The interesting features were the central scotoma as the primary symptom, and the effectiveness of X-ray therapy, which is generally considered ineffective in the chromophobe type of pituitary adenoma. (7 figures.)

Ray K. Daily.

Esente, I., and Pisani, D. **Esophthalmoplegic acute syndrome with amaurosis in the course of tuberculous meningitis treated with streptomycin.** Riv. oto-neuro-oftal. **24**:150-160, March-April, 1949.

A man, 30 years of age, with manifestations of general tuberculosis was admitted to the hospital where he was given streptomycin because of specific meningitis. After about a month of this treatment an esophthalmoplegic syndrome was noted, that is, esotropia with partial paralysis of the left third nerve with almost total amaurosis of the left eye. The fundus showed also a peripapillary edema and venous stasis. Pressing the bulb backward caused pain that was referred to the apex of the orbit. All these symptoms disappeared in a few months. The authors ascribe these manifestations to a periostitis of the apex of the left orbit, optic neuritis, and involvement of the third nerve. (4 references.)

Melchior Lombardo.

Filippi, Paolo. **The unidirectional preponderance of provoked nystagmus.** Riv. oto-neuro-oftal. **24**:340-368, July-Aug., 1949.

A critical review of the observations and conceptions of different authors makes it clear that preponderance of unidirectional provoked nystagmus is an index of vestibular tonus that is bilaterally unequal. The writer lists the types of lesions in which the phenomenon occurs. (2 figures, 84 references.)

Melchior Lombardo.

Hirsch, Oscar. **The significance of the fundus of the eye for the diagnosis of a hypophyseal tumor.** Monatschr. f. Psychiat. u. Neurol. **117**:236-240, April-May-June, 1949.

Papilledema is not a characteristic attribute of hypophyseal tumor, for the chiasm does not lie in the chiasmal sulcus but at the distance of ¾ cm. above the sulcus. In acromegaly we may often find an entirely normal disc with the characteristic field defects though the sella is enormously widened. The anterior arc of the circle of Willis lies above the chiasm. It is quite rigid and adherent to the base of the skull and therefore cannot be displaced. The pulsating, horizontal anterior communicating artery cuts into the elevated chiasm and the optic nerve producing thereby the characteristic field defects. Pressing upon the optic nerve it hinders the spinal fluid from entering into the nerve sheath and thus prevents the formation of papilledema, optic neuritis, or secondary optic atrophy. The papillomacular bundle is more sensitive and therefore we see temporal pallor of the disc. A white disc does not necessarily mean a bad prognosis. The chiasm is very resistant and a complete restitution was often noted after an operation. Suprasellar tumors cause symptoms like any other intracranial tumor.

R. Grunfeld.

Hussain, K. K. **Chronic progressive external ophthalmoplegia.** Brit. M. J. pp. 1392-1393, Dec. 17, 1949.

A man, aged 39 years, who was born in Rumania and had wandered about Eastern Europe and the Middle East had been in England since 1947. In 1933 he developed suppurating cervical glands; in 1935 he had pneumonia, and in 1942 typhoid fever. While he was in Egypt, at the age of 36, he noticed drooping of his left eyelid. In April, 1949, he came to the hospital complaining of dizziness, double vision, and cough. There was marked ptosis of the left eye. Asymmetrical external ocular palsies were present. The pupils were equal and circular, and reacted normally to light. The fundi were normal. Perimetry showed very slight symmetrical diminution of the peripheral parts of the visual fields in each eye. No abnormality of other cranial nerves was observed and all reflexes and sensations were unimpaired. Examination revealed no other physical signs. The cerebrospinal fluid was normal, and the blood pressure was 130/80. X-rays of chest and skull were normal, and the blood Wassermann reaction and Kahn test were negative. To exclude myasthenia gravis a therapeutic test was done (2.5 mg. neostigmine plus 1/100 gr. (0.65 mg.) atropine), but, as expected, no improvement in the eye movements was observed.

Theodore M. Shapira.

Jorio, Sergio. **Two cases of encephalic-parkinsonism with ocular symptomatology.** Riv. oto-neuro-oftal. **24**:301-309, July-Aug., 1949.

One is the case of a man 36 years old who for two years had had intermittent blepharospasm, increasing debility of the elevators and dizziness on bending forward. Other ocular symptoms were paresis of convergence, lack of pupillary reaction to accommodation, nystagmoid movements of the eyes on lateral excursions and spasm of the retinal vessels. The other patient, a woman of 22 years, could not adduct the left eye and the excursions in elevation were limited and nystagmoid. The pupils were round and anisocoric, the photomotor reflex was sluggish and there was a tendency to hippus. The vision was less than 1/10 and the optic nerves were subatrophic. (7 figures, references.)

Melchior Lombardo.

Leoz, G. **Alcohol-nicotine amblyopia.** Arch. Soc. oftal. hispano-am. **9**:821-838, Aug., 1949.

Leoz reports three cases in detail, with illustrations of the visual fields. An analysis shows that the symptoms characteristic of alcohol-tobacco amblyopia may be produced by either alcohol alone, tobacco alone, or by a combination of the toxins. One patient recovered after abstention from tobacco, without discontinuing the use of alcohol. The other two recovered after withdrawal of alcohol, while they continued to smoke. Leoz discusses the pathogenesis of these cases on the basis of the literature and on clinical observations. The administration of vitamins was apparently without any detectable effect. He concludes that the primary lesion is due to a hypovitaminosis, which affects the ganglion cells of the macula, and suggests the term "primary nutritional degeneration of the macula" for this disease. He reserves the term of "retrobulbar neuritis" for descending lesions, which attack primarily the optic nerve. (8 visual fields.)

Ray K. Daily.

Luzzatto, A., and Brognoli, C. **A case of syringobulbia with manifestations of neuroparalytic keratitis in early childhood.** Riv. oto-neuro.-oftal. **24**:166-179, March-April, 1949.

A case is reported of a man of 27 years who early in life became affected by symptoms of syringobulbia and manifestations of neuroparalytic keratitis. These

started at the age of three years in the left eye which was enucleated because of severe pain and in the right eye at the age of seven years. A large corneal opacity resulted. A complete neurologic examination is reported. (5 figures.)

Melchior Lombardo.

Mata Lopez, Pedro. **The importance of a fundus examination in vertigo of vascular origin.** Arch. Soc. oftal. hispano-am. **9**:703-709, July, 1949.

Stemming from the basilar trunk, the auditory, vestibular and central retinal arteries form a part of the cerebral circulation. Functional vertigo is due to vascular disturbances. In such cases an examination of the fundus gives a reliable indication of the condition of the auditory and vestibular vessels. The ocular symptoms encountered in vascular angiopathy of the labyrinth are those of moderate angiosclerosis, with Gunn's sign, arterial tortuosity, diminution in caliber, and fusiform constrictions. Instability of the arterial retinal pressure, which may be high or low, is characteristic of a functional disturbance. Similar changes in the auditory and labyrinthine circulation affect the pressure in the endolymph and in this way produce vertigo. A fundus examination also affords therapeutic guidance, vasodilators or vasoconstrictors being selected on the basis of the retinal arterial pressure. Ray K. Daily.

Montresor, Dante. **The pneumocisternographic studies as an essential element for the diagnosis of opticochiasmatic arachnoiditis.** Riv. oto-neuro-oftal., **24**: 322-339, July-Aug., 1949.

In three of eight patients the clinical symptomatology was clear enough for the proper diagnosis; in the others diagnosis could be made only as a result of Belloni's cisternographic method. In three patients operated upon the arachnoiditis was of the adhesive type. In these cases the vision improved to a maximum of 3.50. (2 figures, references.)

Melchior Lombardo.

Morone, G., and Andreani, F. **Pupillographic researches in Bernard-Horner syndrome.** Riv. oto-neuro-oftal. **24**:180-194, March-April, 1949.

The writers investigated the pharmacodynamics of this syndrome and also of the irritative oculo-sympathetic syndromes by observing the pupillary reaction after instillation of pupillomotor drugs. A differential diagnosis is made by noting the changes of the pupil effected by the action of the drug on the first, second or third neurone of Foerster. Three groups were tested: subjects in whom the site of the lesion was known; subjects in whom it was unknown and subjects having oculosympathetic irritative syndromes. Considerable difficulty may arise in the interpretation of the results obtained from these schemes. (39 references.) Melchior Lombardo.

Noto, P. **A case of Recklinghausen's disease with serious ocular lesions.** Giorn. ital. oftal. **2**:137-144, March-April, 1949.

The author describes a case of Recklinghausen's disease with lesions of the left eye, which resulted in loss of vision from secondary glaucoma. (2 figures.)

Vito La Rocca.

Rucker, C. W. **Defects in the visual fields resulting from increased intracranial pressure.** New York State J. Med. pp. 2417-2421, Oct. 15, 1949.

The author shows by presenting cases that localization of the lesions by means of field losses may mislead the examiner. This is true particularly in choked disc found late in a brain tumor with field pattern that suggests a chiasmal or prechiasmal lesion. On the other hand chiasmal or

prechiasmal field loss without papilledema has exact localizing significance.

Francis M. Crage.

Stoll, M. R. **Pericentral ring scotoma.** Arch. Ophth. **43**:66-91, Jan., 1950.

A review of the perimetry files of the Charlotte Eye, Ear and Throat Hospital, which includes about 3,000 cases, revealed fairly narrow ring scotomas in 34 cases, or a total of 46 eyes. In an additional three cases there were partial ring scotomas. Many of these scotomas could be demonstrated only by careful investigation of the central area, with use of a very small fixation object and very sensitive test objects. Frequently, the scotomas were associated with good acuity and with little ophthalmoscopic evidence of pathologic alteration. Included in this series are examples of a variety of conditions in which Traquair indicated that such ring scotomas may occasionally be found. Of special interest are the few cases similar to those reported by Fuchs, in which ring scotomas were demonstrated in association with subjective complaints following trauma which did not cause basal fracture or direct injury to the eye. It is suggested that these ring scotomas may represent changes associated with vascular disturbance following shock. It was usual to find only one eye affected in men with narrow scotomas. Central angiospastic retinitis is suggested as the most appropriate diagnosis in several cases of this type. Slightly broader ring scotomas, and the narrower scotomas found in women and in older men, are found in association with disease of the optic nerve, as well as with choroidal and retinal disturbances.

Ralph W. Danielson.

Tronconi, V. **Retraction nystagmus as a symptom of cerebral lesion.** Riv. oto-neuro-oftal. **24**:195-206, March - April, 1949.

This type of nystagmus was seen in a boy of 14 years who showed a paresis of the right external rectus and paralysis of upward excursions. On attempting to move the eyes upward the globes showed rhythmic movements of retraction and protrusion which disappeared when the patient stopped in his attempts. A choked disc was present in each eye. Tronconi describes the character of the nystagmus, and discusses the differential diagnosis of the pathogenesis of some similar conditions. It is assumed that this type of nystagmus is a symptom of a mesencephalic lesion affecting the supranuclear oculomotor pathways. (22 references.)

Melchior Lombardo.

14

EYEBALL, ORBIT, SINUSES

Cristini, G. **Bilateral exophthalmos of malignant type and bilateral internal megacarotid with pericarotideal neuritis.** Riv. oto-neuro-oftal. **24**:232-244, May-June, 1949.

Years after a severe head trauma which was followed by vertigo and headaches a man of 48 years developed an exophthalmos with corneal complications on the right side, and a few months later on the left side. Arteriography showed a bilateral marked dilatation of the carotid artery and its orbital branches. The improvement of the ocular symptoms was obtained by alcoholization of the sphenopalatine ganglion which is one of the two ganglia that regulate the parasympathetic impulses of the carotid and its branches. (4 figures, 30 references.)

Melchior Lombardo.

Lindner, K. **Traction in myopia and its prevention.** Arch. f. Ophth. **149**:293-317, 1949.

The stretching of the sclera is caused by the action of metabolites. The special involvement of the macular area results from larger number of capillaries and the

increased metabolism of this district and also from diminished scleral protection.

Ernst Schmerl.

Di Luca, Giuseppe. **Traumatic pulsating exophthalmos and spontaneous recovery.** Riv. oto-neuro-oftal. **24**:67-286, May-June, 1949.

A 24-year-old woman developed unquestionable signs of arteriovenous aneurysm after trauma, and menstruation became irregular. Two years later she had another fall which left her unconscious for a short time. On the same day, she noted that the bruit had disappeared. Soon after, the exophthalmos receded and menstruation reappeared. The disappearance of menstruation just at the onset of the aneurysm and its reappearance after recovery is a differential sign between intracranial and intraorbital aneurysm. (4 figures, references.)

Melchior Lombardo.

Mueller, H. K. **The surgical treatment of fresh eyeball and lid wounds.** Ophthalmologica **118**:924-939, Oct.-Nov., 1949.

The writer had a very unusual amount of experience with fresh war injuries to the eye and its adnexa. He advocates immediate surgical repair so planned that no further surgery will be necessary for quite some time. In the case of large traumatic lid defects he recommends immediate plastic repair by means of sliding flaps and three rules must be observed. Injuries to the eyeball must be repaired before the lid is repaired. The same rule applies to the sinuses. If involved in the injury, they must be carefully cleaned and drained into the nose before the lid wounds can be closed. If these two requirements can not be met, immediate plastic repair of the lid wounds is contraindicated. If primary plastic repair is permissible, it is important to mobilize and undermine the skin to such an extent that all wound lips can be united without tension. If tension cannot be eliminated altogether metal traction sutures and metal pegs should be applied to skin portions several centimeters away from the wound lips. Injuries which have destroyed parts of the lids, most of the conjunctiva and the eyeball call for immediate repair of the socket with mucous membranes from the mouth. In three such cases complicated by injury to the oral cavity, Mueller rebuilt the socket with pieces of human conjunctiva obtained from the dead. In all three cases the graft took, but was gradually invaded and replaced by granulations starting from conjunctival remnants. The immediate plastic repair permitted closure of the wound and insertion of a small conformer.

Well approximated corneal wounds do not require surgical repair. For the repair of gaping corneal wounds the writer prefers conjunctival flaps. Such flaps should be single-based (should not be bridge flaps) with firm anchorage of the tip so that they can really brace the corneal wound. Corneal sutures should be inserted only if the bracing effect of a conjunctival flap does not bring about exact apposition of the wound lips. During the insertion of corneal sutures the cornea should not be grasped with forceps. Large corneal defects can be repaired by primary keratoplasty. In ten cases of complete destruction of one eye and loss of the cornea of the other eye, the writer performed total keratoplasties resulting in eight takes. All his patients were evacuated after four to five weeks so that the final outcome of the surgery is not known. Large incised wounds of the sclera should be repaired carefully and thoroughly. Exposure of the injured portion of the globe may necessitate mobilization of the lids by large surgical incisions along the orbital rim. The giant magnets have proved too unwieldy and Hirschberg's hand magnet too weak. A new, easily movable and easily adjustable

giant magnet for use close to the front devised by Dieter has been found very satisfactory. Peter C. Kronfeld.

Sabbadini, D. **Neurofibroangioma of the orbital infundibulum.** Riv. oto-neuro-oftal. **24**:207-216, March-April, 1949.

A boy, 16 years of age, had a moderate degree of exophthalmos on the right side. The excursion of the eyeball and pupillary reactions were normal. There was choked disc with edema on the nasal side of the disc. The visual field was contracted so that vision remained only in the lower temporal quadrant. The radiographic examination showed an enlargement of the optic foramen and marked halisteresis of the lesser wing of the sphenoid. A diagnosis of intraorbital growth well back in the orbital apex was confirmed at the operation which was performed under local anesthesia through a right frontal osteoplastic flap. (7 figures.) Melchior Lombardo.

Schlander, E. **Atypical localization of mucocele of frontal sinus with rare retinal findings.** Wien. klin. Wchnschr. **61**: 718-719, Oct. 21, 1949.

Schlander reports the case of a woman, aged 48 years, with exophthalmos and descended right bulbus. A solid tumor which firmly adhered to the orbital roof was papable at the upper lateral orbital edge behind the bulbus. The bulbus was freely movable. There were delicate folds of the retina in the area of the posterior ocular pole and somewhat above the papilla. A tumor, discharging a thick, mucous fluid, was exposed by orbitotomy. Roentgenologic examination revealed a defect in the orbital roof, the localization of which was atypical. A hypertrophic inflammation of the frontal sinus presumably had occurred some time before and resulted in the occlusion of the nasofrontal duct and in an inflammation in a laterally situated recess of the frontal sinus. Increased swelling caused erosion of bone and breaking through into the orbit. The eyeball was pressed against the rigid bony lateral nasal wall with a change in shape and the formation of folds in the retina. When the bulbus remains freely movable, the process within the orbit is nonmalignant. A malignant tumor breaking through into the orbit soon causes fixation of the bulbus.

Theodore M. Shapira.

Walser, E. **The use of paladon implants in bony defects of the orbit and its neighborhood.** Arch. f. Ophth. **149**:355-363, 1949.

Paladon is a resin commonly used in dentistry. It is firm, of low specific gravity, of low conductivity for heat and is chemically inactive. The author has used it in more than 20 cases and presents several pictures showing satisfactory results.

Ernst Schmerl.

15

EYELIDS, LACRIMAL APPARATUS

Agnello, Francesco. **Cutaneous leishmaniasis.** Giorn. ital. oftal. **2**:231-236, May-June, 1949.

The author presents a new case of Orient button of the prelacrimal region, observed in Siracusa and cured by electrocoagulation. This therapeutic technique is the most effective and economical of those used in the cure of cutaneous leishmaniasis. Vito La Rocca.

Braithwaite, Fenton. **Melanosis of the eyelids.** Brit. J. Plast. Surg. **1**:206-211, 1948-1949.

Two cases of melanosis of the eyelids are presented. In one an acquired melanosis, which became malignant and in which the pigmentation spread widely appeared in the fifth decade. Biopsy showed a melanotic carcinoma. It responded to a combination of radiation and surgery. In

the other a congenital melanosis of the eyelids was followed for several years. Its clinical course indicates that it is benign or at most only locally invasive. Congenital blue nevi should be excised in childhood. Acquired melanosis of the eyelid is precancerous and if at its appearance it is treated by surgery or radiation or both, the prognosis is good. Alston Callahan.

Calogero, V. N. **Elongated lacrimal canaliculi of the upper and lower lid.** Giorn. ital. oftal. **2**:237-242, May-June, 1949.

A case of elongated lacrimal canaliculi of the upper and lower lid is described, which because of several factors is different from all others hitherto discussed, and is therefore studied as one of the many forms which interested Waardenburg. The development of this anomaly can be attributed to malformation of facial bones noticeable even in photographs taken during the examination of the patient. Vito La Rocca.

Farina, R., and de Toledo Piza, P. **Blepharoptosis. Blepharoplasty by a modified Wiener-Lexer technique.** Plast. and Reconstr. Surg. **5**:97-101, Jan., 1950.

After a short reference to etiology, types and symptomatology, four cases of blepharoptosis are presented, which were treated surgically by the modified Wiener-Lexer technique of using a free transplant of fascia lata to attach the lid to the frontalis muscle. The authors use this type of repair for all cases of ptosis, regardless of types. Alston Callahan.

Marin Amat, M. **The superiority of Motais's operation in the treatment of ptosis.** Arch. Soc. oftal. hispano-am. **9**: 727-735, July, 1949.

The subject of ptosis and the multitude of procedures for its correction are reviewed. The author advocates the Motais operation because it affords the best results functionally and cosmetically. He uses it with the following modifications. 1. Instead of a central flap of the superior rectus, he transplants the outer half of the muscle, fixing the entire border firmly with a silk thread. 2. The suture is placed 1 cm. from the muscular insertion, which fortifies the functional effect of the transplanted portion of the superior rectus. 3. The external portion of the superior rectus is inserted exactly into the middle portion of the upper lid. 4. The sutures are tied in the skin over a bead, and left there until cicatrization is complete, on the average about two weeks. (2 figures.)

Ray K. Daily.

New, G. B. **Cancer of the face: treatment and plastic repair.** Plastic and Reconstr. Surg. **4**:528-536, Nov., 1949.

Patients with cancer of the face do not receive as efficient treatment as one would expect from the site of the lesions and the facility with which a diagnosis can be made. Because of the comparative ease of diagnosis, lesions of the face should not be treated conservatively because of the probability of recurrence of the growth and fixation to cartilage or bone, and metastasis to the neck. In most cases, biopsy is contraindicated because the trauma resulting from the removal of the specimen makes it impossible to determine how much of the enlargement is the result of the tumor and how much is the result of reaction from the trauma caused by the removal of the specimen. Sometimes in removing the specimen for biopsy, the incision is placed so that it interferes with a pedicle flap or a rotation flap that might be employed in a reparative procedure.

In the surgical management of malignant tumors of the face, either sharp dissection or electrocoagulation (surgical diathermy) may be employed, depending upon the site and size of the lesion. In eleven cases demonstrated by 28 illustra-

tions, the management of the following adnexal problems are shown. A basal cell epithelioma of the lateral canthus, a basal cell epithelioma of the entire lower lid, and a large basal cell epithelioma of the orbit and forehead. Other cases illustrate the management of malignancies of the nose, face, lips and jaws. Complete primary removal of carcinoma of the face is essential. Examination of fresh frozen sections of tissue at the time of operation aid in determining the best treatment. In cases in which the tumor recurs and becomes fixed after irradiation, the examination of fresh frozen sections is an aid to determine the limits of the growth.

Alston Callahan.

Rychener, R. O. **Modern concepts of treatment in disorders of the lacrimal apparatus.** Minnesota Med. **32**:991, Oct., 1949.

In congenital stenosis, passage of small o or oo Bowman probes are preferred to the giant Ziegler probes. Slitting of the canaliculus corrects epiphora even if the common duct is constricted. Lacrimation from hypersecretion calls for X-ray therapy of the gland or cocainization or alcohol injection of the sphenopalatine ganglion. Closure of the puncta is advised in hyposecretion. Chronic dacryocystitis, regardless of age and the size of the sac, is best treated by the Dupuy-Dutemps dacryorhinostomy. Francis M. Crage.

Šafář, Karl. **Simultaneous restoration of both eyelids by extension of the surgical procedure of Wendell L. Hughes.** Wien. klin. Wchnschr. **61**:713-714, Oct. 21, 1949.

Although the procedure of Hughes in which one lid is reconstructed out of another one, with temporary closure and later reopening of the palpebral fissure, was recommended originally for the restoration of the lower lid, Šafář has used it successfully for the restoration of the upper from the lower. The case he describes exemplifies the problem involved in the restoration of both lids simultaneously. After melanotic tumor tissue had been removed from the right eye, there remained of the upper lid only a medial remnant and of the lower lid practically nothing. However, the melanotic tissue did not go very deep so that in the upper lid it was possible to preserve the upper portion of the tarsus. The tarsus was freed at the external angle of the lid and the remnant sutured with catgut into the external angle. In the lower lid the conjunctiva of the fornix was freed and fastened outward by means of catgut. The skin above and below was extensively undermined and drawn over the conjunctiva and sutured together over the eye by means of silk sutures. The palpebral fissure remained closed for three months and then was opened. One month later the rims of both upper and lower lids were smooth and the eye could be opened and closed. Theodore M. Shapira.

De Saint-Martin, R. **Lid restorations by sliding flaps.** Ophthalmologica **118**: 879-892, Oct.-Nov., 1949.

The Hungarian method of repairing lid defects by means of skin flaps sliding along arcuate incisions is shown to have developed out of older sliding techniques such as Dieffenbach's and Burow's. By varying the curvature of the arcuate incision and the number, size and direction of the triangular excisions the Hungarian method can be used for the correction of most lid defects. It can be successfully combined with bone and cartilage grafts. The diagrams which accompany the paper are unusually lucid, but there are very few photographic records of results obtained with the Hungarian methods.

Peter C. Kronfeld.

Schlagenhauff, Kurt. **Mucocele of ethmoid in the region of the lacrimal sac.**

Wien. klin. Wchnschr. **61**:716-718, Oct. 21, 1949.

After briefly describing the clinical picture that results from a mucocele in the region of the orbit, Schlagenhauff presents the case of a patient, aged 49 years, who earlier had undergone extirpation of the lacrimal sac and ten years later a mucocele of the ethmoid. Roentgenoscopy disclosed a shadow in the frontal and maxillary sinus on the right side as well as a veiling of the ethmoid cells and several septa were missing. These two and the case here presented demonstrate that a paralacrimal mucocele can be completely removed. For surgical treatment the endonasal approach is preferable since it permits preservation of the lacrimal sac. A search of the literature revealed only two similar cases and these are briefly reviewed. Theodore M. Shapira.

Sédan, Jean. **Supernumerary lacrimal canaliculi and congenital fistula in five members of the same family.** Ann d'ocul. **182**:855-858, Nov., 1949.

These unusual abnormalities were observed in a grandfather, two daughters and two granddaughters. The supernumerary canaliculi were limited to the lower lid, varied from one to three in number and were either round or slit-shaped. In no case did the additional canaliculi join with the lacrimal sac directly. In two cases lacrimal fistulas due to intrauterine dacryocystitis were greatly improved after the use of sulfonamide irrigation. The fistulas were finally closed with galvanocautery. Chas. A. Bahn.

Stallard, H. B. **Ectropion corrected by bridge-pedicle graft.** Brit. J. Plast. Surg. **1**:77-80, 1948-1949.

A type of ectropion is described which is characterized by marked hypertrophic changes in the everted palpebral conjunctiva and subconjunctival tissue. The everted conjunctiva is thick, swollen and keratinized, and the skin of the lower lid becomes shortened and its mobility impaired. The author has seen four such cases in the last 20 years. This condition is corrected by excision of the everted conjunctiva and mobilization of the remaining palpebral conjunctiva to line the posterior surface of the lid. Then a bridge-pedicle graft is transposed from the upper lid just beneath the eyebrow across the palpebral fissure into the dissected defect of the lower lid and sutured into position. It thereby forms the skin of the lower lid and affords a sling for holding it up correctly. To prevent postoperative contraction, paramedian tarsorrhaphies were also constructed. Healing was by first intention and the four figures show the excellent result.

Alston Callahan.

Ziegler, A. **Allergic nature of Mikulicz's syndrome.** Wien. klin. Wchnschr. **61**:722-724, Oct. 21, 1949.

Ziegler reports one case of Mikulicz's syndrome in a man aged 65 years, who died one year after diagnosis was established. The clinical as well as the anatomicopathologic and microscopic observations strongly support the concept that Mikulicz's syndrome may be considered as an allergic phenomenon affecting the lacrymal and salivary glands. Tuberculosis as well as syphilis and other diseases may be considered responsible for the sensitization.

Theodore M. Shapira.

16

TUMORS

Davids, Bernd. **Genesis of melanotic tumors.** Arch. f. Ophth. **149**:449-459, 1949.

Disturbances of the pigmentary metabolism are considered a primary factor in the development of melanotic tumors.

Ernst Schmerl.

Esente, Ivan. **Cylindromatosic tumors of the lacrimal gland.** Giorn. ital. oftal. **2**:193-213, May-June, 1949.

The author observed a case of cylindromatosic tumor of the lacrimal duct and discusses the hystogenic problem of mixed tumors of the lacrimal gland. Such tumors were at one time considered benign, but justify a much more guarded prognosis in a high percentage of cases.

Vito La Rocca.

Fleming, Norman. **Adeno-carcinoma (mixed tumor) of the lacrimal gland.** Brit. J. Ophth. **33**:763-769, Dec., 1949.

One year after apparently complete excision of the gland, the patient had local and generalized metastasis. The mesodermal origin is explained as arising from the metaplasia of the epithelial cells. Cases of direct spread metastasis, metastasis to lymphatics and general dissemination have been reported. (2 photomicrographs). Orwyn H. Ellis.

Montanelli, M. **Chloroma of the orbit.** Boll. d'ocul. **28**:424-432, July, 1949.

A boy, 2½ years of age, developed exophthalmos of the right eye and temperatures around 38° C. A biopsy (photomicrograph) revealed a probable fusocellular sarcoma. Roentgen and nasal examination revealed shifting of the right orbital wall, and a small tumor mass was found in the middle turbinate. The eyeball was dislocated and papilledema was present. Hematologic findings were normal. A few weeks later the eyeball was immobile, the pupil did not react, pressure was increased, and papilledema and retinal hemorrhages were present; the left eye also showed exophthalmos, inferior and temporal deviation and slight papilledema. The patient died at home. A transition between leukemia and malignant tumor was assumed. (2 figures, extensive references.) K. W. Ascher.

Orsoni, José. **Orbital localization of malignant lymphogranuloma.** Giorn. ital. oftal. **2**:129-136, March-April, 1949.

The author describes a case of lymphogranuloma of the cervical glands, verified histologically, with orbital lesions which diminished in size after Roentgen therapy. The patient died three months after discharge from hospital. (4 figures.)

Vito La Rocca.

Philps, Seymour. **Choroidal sarcoma with metastasis in the opposite orbit.** Brit. J. Ophth. **33**:732-739, Dec., 1949.

A woman, 10 years after enucleation of one eye for choroidal sarcoma, developed an encapsulated metastasis in the opposite orbit. The tumor was within the muscle cone, completely encapsulated, and attached to the under side of the external rectus muscle. It was a malignant melanoma of the choroid, and comparison showed that it was undoubtedly a metastasis from the original growth. No similar case has been reported.

Orwyn H. Ellis.

Radnot, Magda. **Rare malignant tumors of the eyelid.** Giorn. ital. oftal. **2**:101-107, March-April, 1949.

The author reports two cases of rare malignant tumor of the eyelid, a carcinoma of the meibomian gland which relapsed after four years with metastasis in the pre-auricular gland and an angioblastic sarcoma of the lower eyelid. Sections were made of both tumors, showing their malignancy. (8 figures.)

Vito La Rocca.

Stetson, C. G., and Schulz, M. D. **Carcinoma of the eyelid.** New England J. Med. **241**:725-732, Nov. 10, 1949.

The report was based on the analysis of 301 cases seen between 1933 and 1944. Tables amply provide information concerning type, age incidence, and other im-

portant factors. Any of the available techniques carefully applied yields good results. Because of the ease of treatment and the fine cosmetic and functional results X-ray radiation is the treatment of choice. Not a single case of radiation cataract was found. Francis M. Crage.

18

SYSTEMIC DISEASE AND PARASITES

Donahue, H. C. **Migraine and its ocular manifestations.** Arch. Ophth. **43**:96-141, Jan., 1950.

This review of the literature on migraine is so complete as to make abstracting inadequate. So-called ophthalmoplegic migraine may be a form of recurrent oculomotor paralysis with headache, and not a form of migraine. Ophthalmic migraine is a term used to describe the ocular manifestations of migraine, such as recurrent scintillating scotomas and hemianopsia without headache. Such forms may occur or be preceded or followed by the usual classic type of migraine; ocular migraine is the term reserved for headache of ocular origin which resembles migraine. However, it has none of the characteristics of migraine and should not be called migraine as it usually results from such factors as errors of refraction, extraocular muscle imbalance or aniseikonia. Five case reports are presented.

Ralph W. Danielson.

Friemann, W., and Magun, R. **Nutritional deficiencies of the nervous system in prisoners of war.** Arch. f. Ophth. **149**: 437-448, 1949.

In five prisoners of war in Egypt there was pronounced deterioration of the central vision, tinnitus, hoarseness, weakness of the legs, burning sensations in both feet and skin involvement. A vitamin B deficiency seemed to be a decisive etiologic factor. Ernst Schmerl.

Glover, L. P. **Onchoceriasis in America.** Pennsylvania M. J. **52**:1371-1374, Sept., 1949.

This disease is a form of filariasis carried from an infected individual by the simulium fly and endemic on this continent, in Guatemala, and two states in Mexico. The disease is easily diagnosed by microscopic examination of the skin nodules. The filaria and its toxins may invade any tissue of the eye and particularly the anterior uvea, cornea, and the chambers. Sanitation, and, since this article was written, Hetrazen (Lederle), are the effective forms of treatment.

Francis M. Crage.

Hesse, Erich. **A diptera larva in the anterior chamber of the eye.** Wien. klin. Wchnschr. **61**:689-692, Oct. 21, 1949.

The diagnosis of internal ophthalmomyiasis may be difficult, particularly if the larva is located in the posterior part of the eye. Such cases are rarely recognized and may be mistaken for uveal tuberculosis, endophthalmitis, glioma or pseudoglioma. After a brief review of the literature on internal ophthalmomyiasis the author presents the case of a boy, aged 12 years, who had repeated attacks of inflammation in the right eye, which gradually increased in severity, while the visual acuity became steadily worse. The eyelids were edematous, the conjunctiva injected and thickened. The cornea showed diffuse turbidity, and on the posterior wall it had a dense fibrinous covering. The anterior chamber had a hypopyon and above it a worm-like formation. Examination with the corneal microscope revealed not only contractions of some of the segments, but movements of internal organs inside the body of the worm-like larva. The larva was removed through an incision at the corneal limbus. Penetration through the sclera or cornea is unlikely and entrance by way of the blood stream more probable. The boy had

open wounds on one of his legs to which flies had access while he was tending cattle. The repeated bouts of inflammatory reactions and pains, may be ascribed either to a temporary increase in pressure (secondary glaucoma) or to an anaphylactic reaction to the parasite. In serious ophthalmologic disorders, in which the symptoms show intermittent exacerbations, internal ophthalmomyiasis should be thought of. Theodore M. Shapira.

Jagić, N. **Clinical aspects of hypertension.** Wein. klin. Wchnschr. 61:695-696, Oct. 21, 1949.

Jagić says that some patients who consult the ophthalmologist because of visual disturbances are found to have eyeground changes that are characteristic of hypertension. He stresses the importance of determining the blood pressure no matter what the complaint might be. Hypertensive patients may show no symptoms until suddenly they have an apoplectic stroke, acute uremia or cardiac symptoms. In obese patients with hypertension a slow and careful weight reducing regimen frequently reduces the blood pressure and counteracts the symptoms of hypertension. Theodore M. Shapira.

Lech Junior. **Ocular cysticercus.** Arq. do Instituto Penido Burnier **8**:13-64, June, 1949.

With 44 illustrations, including many black and white fundus photographs showing the cysticercus in the interior of the eye, the author reviews the experience of the Penido Institute (Campinas, Brazil) with 111 patients who were carriers of 116 ocular cysticercuses, including 51 in the vitreous, 10 subhyaloid, 44 subretinal, 2 in the anterior chamber, 7 subconjunctival, 1 in the orbit, and 1 subcutaneous in the region of the lacrimal sac. The youngest patient was 2½ years of age and the oldest 66. The author begins with a historical survey of the subject since the work of Schott and Soemmering in 1829.

In suspected cases it is important to explore the inferior part of the vitreous. The complement fixation reaction in the blood is a valuable aid to diagnosis, being positive in 73.2 percent of the cases. With rare exceptions the intraocular cases lead to blindness. In one subretinal case Souza Queiroz and the other Institute workers had the good fortune to be able to localize and extract the organism with retention of normal vision and normal ocular movements. The local anesthetic used was selected because of its freedom from tendency to cause clouding of the cornea, which interferes with localization by ophthalmoscopic study of several diathermic punctures. The internal rectus was divided, the eye fixed by grasping the insertion of the muscle, and the sclera opened cautiously layer by layer, the cyst escaping under the tension created by the forceps. The cyst was 3.5 mm. in diameter. W. H. Crisp.

Maeder, Guy. **The syndrome of Rothmund and Werner.** Ann. d'ocul. **182**:809-854, Nov., 1949.

These syndromes are related, being constitutional, degenerative diseases which most frequently affect the lens, the skin and the genital system. In the Rothmund syndrome nuclear cataracts apparently begin before the fifth year. The cutaneous lesions consist principally of vascular atrophic poikiloderma which is characterized by pigment migration and atrophy of the skin associated with telangiectasis on the upper half of the body. The lesions are very slowly progressive and may become stationary. Females are affected in the proportion of three to one and the pattern of heredity is recessive. In the Werner syndrome punctate cataracts are usually observed between the ages of 16 and 35 years. The cutaneous involvement is a diffuse, progressive

scleroderma involving the lower half of the body and frequently associated with ulcers of the legs or feet. Males and females are affected with equal frequency and the mode of heredity is recessive or irregular dominant. Among the frequent symptoms are band-like corneal dystrophies and infantile facies with little hair on the head or body. Twenty-one cases of the Rothmund syndrome and 46 cases of the Werner syndrome from the literature are analyzed. In addition the author analyzes nine cases of the Rothmund syndrome (five from one group) and two of the Werner syndrome which he has examined. This contribution is the most complete which has been written on this subject. Chas. A. Bahn.

Pochin, E. E., and Rundle, F. F. **Deposition of adipose tissue between ocular muscle fibers in thyrotoxicosis.** Clin. Science **8**:89-96, 1949.

These investigators found that the fat content in the extraocular muscles in thyrotoxic exophthalmos was increased 85 percent above nomal.

Donald T. Hughson.

Ryan, Hugh. **Thyroidectomy and thyrotropic exophthalmos (exophthalmic ophthalmoplegia). A review of 1,001 thyroidectomies.** Brit. J. Ophth. **33**:769-773, Dec., 1949.

The literature on thyroidectomy with thyrotropic exophthalmos is reviewed and case studies from the Royal Free Hospital are analyzed. In the group of 1,001 patients analyzed, only three cases of mild thyrotropic exophthalmos had occured. This condition is an infrequent sequel to careful thyroidectomy.

Orwyn H. Ellis.

Wirth, A., and Bevacqua, R. **Parasitic cysts of the orbit (Filaria Addario).** Giorn. ital. oftal. **2**:225-230, May-June, 1949.

The authors describe orbital cysts caused by Filaria conjunctivae Addario, the first reported orbital localization of this parasite, which is rare in man. The cyst was removed surgically following a supraciliar orbitotomy. A characteristic of these autoctonous filaria is that they give rise to local manifestations only.

Vito La Rocca.

19

CONGENITAL DEFORMITIES, HEREDITY

Meyrán, Jorge. **A case of microphthalmos associated with syndactylia.** An. Soc. mex. de oftal. **23**:48-52, Jan.-March, 1949.

The patient, a girl 11 years of age, had bilateral microphthalmos and syndactylism. W. H. Crisp.

Penido Burnier, J. **Syndrome of Laurence-Moon-Bardet-Biedl.** (Five personal observations) Arq. do Instituto Penido Burnier **8**:65-81, June 1, 1949.

The observations relate to a boy of 6 years, two boys of 10 and 14 years, and two girls of 10 and 14 years. Consanguinity of the parents existed only in two cases, sisters. In the two boys there was adiposogenital dystrophy: one of them had polydactily and both showed mental backwardness. In all the cases the visual disorders predominated over the other symptoms, the most favorable visual acuity not exceeding one tenth of normal. All had extensive tapetoretinal degeneration and hemeralopia. The six-year-old boy had club foot, a complication only previously referred to in the observation by Böck and Risak, quoted by Streiff and Zeltner. (12 figures, references.) W. H. Crisp.

Del Rio Cabanas, Jose Luis. **A case of bilateral microöphthalmia with coloboma of the optic nerve in one eye and a colobomatous excavation of the papilla in the other eye.** Arch. soc. oftal. hispano-am. **9**:870-884, Aug., 1949.

After a comprehensive review of the literature the author reports the case of a woman, 34 years old, who presented herself with a history of poor vision since infancy, and progressive visual loss. She had bilateral enophthalmos and microphthalmos; vision of the right eye was limited to perception of large objects; that of the left could be improved to 1/10 with a ten-diopter lens. The fundus of the right eye had a white, round excavation of 20 diopters in the place of the papilla; the vessels seemed to spring abruptly from the borders of this orifice. The left optic disc presented a 3.5-mm. excavation involving ⅓ of its area on the temporal side. Because of the low visual acuity the visual fields could not be charted. The family history was negative. (3 figures.)

Ray K. Daily.

Straub, Wolfgang. **Several malformations in one eye.** Klin. Monatsbl. f. Augenh. **115**:164-166, 1949.

Microcornea, shrunken cataract, persistent hyaloid artery, high myopia and grayish tissue on a part of the retina were all found in one and the same eye. The disturbance in the development of the early fetal eye lead to an abnormal cornea and to an abnormal bulbus. This prevented the obliteration of the hyaloid artery. Pull by strands from this artery tore the posterior lens capsule, leading to cataract and dislocation of parts of the cataractous lens into the vitreous. (References.)

Max Hirschfelder.

20

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Kirsch, H. **Goethe and spectacles.** Klin. Monatsbl. f. Augenh. **115**:109-111, 1949.

The article quotes instances from Goethe's writing which demonstrate his aversion to people wearing glasses. However, there is a lorgnette among Goethe's belongings with −2.00 spheric lenses. The author concludes that Goethe had a mild refractive myopia in his late years and proves his contention by quotation from his writings. Max Hirschfelder.

Matthaei, Rupprecht. **Goethe's method of examining color blind people.** Klin. Monatsbl. f. Augenh. **115**:97-108, 1949.

The author reconstructs Goethe's experiences with color blind people from old notes found in manuscripts and in Goethe's writings. He imitated the experiments with a color blind medical student and compares his experiences. (7 figures.) Max Hirschfelder.

Post, M. H. **Function of the section on ophthalmology.** J.A.M.A. **141**:961-963, Dec. 3, 1949.

The function of the Section on Ophthalmology of the American Medical Association differs from that of any other society in America. This organization not only should offer an opportunity for the presentation of scientific programs but also should give ophthalmology a place where its various problems may be discussed and analyzed and where suggestions may be made for their proper solution. A leading function of the section is the responsibility of speaking as an official mouthpiece of the ophthalmic profession of the United States, and to express itself as such, through the proper channels, to the House of Delegates of the American Medical Association has become its obligation. The large attendance at the executive sessions attests to the fact that there is a general recognition of this responsibility by the members. Though at times the long duration of arguments and the slightly turbulent atmosphere may be distressing, this is the forum where differences of opinion should

be settled. These discussions are a proper function of this body. The controversial question regarding the teaching of optometrists by ophthalmologists should find its answer here. The recent trend toward the socialization of medicine is, without doubt, by far the major problem confronting ophthalmology. It must not be forgot that these meetings are limited as to time and that there are functions other than those concerned with the formulation of policies and ethics that are of importance. Here, also, should be the forum for the presentation of scientific papers. This is the place where all, from the youngest to the oldest member of the specialty, should be heard when they wish to present ideas of outstanding worth.

Theodore M. Shapira.

Viteles, M. S. **Visual standards and flight performance.** J. Aviation Med. **18**: 528-547, Dec., 1947.

This study was taken in an attempt to evaluate how well persons with various degrees of visual deficiency can learn to fly, compared with those having perfect vision. The candidates for flight training were divided into four groups which are: A. Normal vision without glasses, B. Normal vision with glasses, C. Relatively subnormal vision, and D. Only one eye correctible to 20/20. Thirteen tests were used to determine the qualification of these men; 194 students began training and only 145 completed the training. Only 15 percent of the A group and 21 percent of the B group were excluded from further training, but 30 percent of the C group and 47 percent of the D group were. There were no accidents in any of the four groups during flight training which totaled over 8,000 hours during this program. (10 tables, 4 figures, 2 exhibits.)

H. C. Weinberg.

NEWS ITEMS

Edited by Donald J. Lyle, M.D.
601 Union Trust Building, Cincinnati 2

News items should reach the editor by the 12th of the month but, to receive adequate publicity, notices of postgraduate courses, meetings, and so forth should be received by the editor at least three months before the date of occurrence.

Deaths

Dr. Joseph W. Charles, St. Louis, Missouri, died February 10, 1950.

Wanted

Polish abstractor

The Journal is in need of an abstractor to review the current Polish literature. For further information, please communicate with the abstract editor, Dr. F. Herbert Haessler, 561 North 15th Street, Milwaukee 3, Wisconsin.

Announcements

Treacher Collins prize essay

The Council of the Ophthalmological Society of the United Kingdom is offering for the Treacher Collins Prize Essay the sum of £100, awarded triennially, for the best essay in English submitted on a selected subject, which for the next award is "Exophthalmos in relation to endocrine disorder."

The competition is open to qualified medical practitioners of any nationality. The closing date for sending in essays is September 30, 1951.

The essays should be submitted to the Honorary Secretary, Ophthalmological Society of the United Kingdom, 45 Lincoln's Inn Fields, London, W.C.2, from whom also any further information may be obtained. No name should be on any essay, but a distinguished pseudonym or quotation, which should be on a sealed envelope containing the candidate's name and address, should accompany the essay.

Course on oculorotary muscles

The Department of Ophthalmology of Washington University School of Medicine, Saint Louis, will present its annual, short, intensive course on the oculorotary muscles from June 12th through June 24th. The course will be limited to nine students and will include 28 hours of didactic instruction, 27 hours of clinical instruction, and 10 hours of surgical demonstration.

The instructors will be Dr. Richard G. Scobee, Dr. George T. Stine, and Dr. David M. Freeman. Tuition will be $150 and only those at least eligible for the American Board of Ophthalmology will be accepted. Inquiries about the course should be addressed to Dr. Richard G. Scobee, 640 South Kingshighway Boulevard, Saint Louis 10, Missouri.

Research Association annual meeting

The annual meeting of the Association for Research in Ophthalmology, Inc., will be held June 24th and 25th, the two days preceding the meeting of the American Medical Association, in San Francisco.

It is suggested that reservations be made early through the reservation bureau for the A.M.A. It is hoped that all members will plan to attend the Section on Ophthalmology meeting of the A.M.A.

Ann Arbor courses

Ophthalmology will be one of the subjects included among the spring and summer courses in postgraduate medicine being offered by the University of Michigan Medical School. Among the guest lecturers for the course in ophthalmology will be: Dr. Herman Elwyn, senior assistant surgeon, New York Eye and Ear Infirmary; Dr. John B. Hitz, Milwaukee; Dr. Albert E. Sloane, Harvard University Medical School, Boston; Dr. Kenneth C. Swan, University of Oregon Medical School, Portland; and Dr. Paul L. Cusick, Detroit.

Orthoptic examinations

Applications for the examination of orthoptic technicians to be conducted by the American Orthoptic Council in September and October, 1950, will be received by the office of the secretary, Dr. Frank D. Costenbader, 1605 22nd Street, N.W., Washington 8, D.C., until July 1st. Applications must be accompanied by the examination fee of $25.

Miscellaneous

Stanford University conference

A postgraduate course in clinical ophthalmology was held at the Stanford University School of Medicine, San Francisco, from March 27th to March 31st. Dr. A. Edward Maumenee, Jr., Dr. Dohrmann K. Pischel, Dr. Earle H. McBain, Dr. Jerome W. Bettman, and Dr. Arthur J. Jampolsky were instructors.

Wills Hospital clinical meeting

Dr. Walter Parker, Detroit, was guest of honor at the second annual clinical conference of the staff and ex-residents of the Wills Eye Hospital, Philadelphia, held on March 17th and 18th.

Presiding at the Friday morning meeting, Dr. Louis Lehrfeld introduced the following speakers: Dr. Burton Chance, who spoke on "Destruction of the macula by indirect force"; Dr. William F. Whelan, "Orbital complications of paranasal sinus disease"; Dr. Irving H. Leopold, "Present status of newer antibiotics in ophthalmology."

At the Friday afternoon meeting, Dr. James S. Shipman presided. Speakers were: Dr. Raynold N. Berke, "Causes of vitreous loss"; Dr. I. S. Tassman and Dr. Perce DeLong, "Pathological studies of corneal wound repair following use of fibrin coagulum: A preliminary report"; Dr. P. Robb McDonald and Dr. James E. Purnell, "The dislocated lens."

Speakers at the Saturday morning session were: Dr. William J. Harrison, "Glioma of the optic nerve"; Dr. Joseph W. Hallett, "Clinical and experimental studies with tissue scrapings in external ocular diseases"; Dr. Wilfred E. Fry, "Juxtapapillary malignancy"; Dr. Roscoe J. Kennedy, "Results of stellate block in treatment of retinitis pigmentosa." Presiding at this session was Dr. Warren S. Reese.

Dr. I. S. Tassman presided at the Saturday afternoon session. The following papers were presented: "Some experimental cataract procedures, instruments, and sutures," Dr. Warren S. Reese and Dr. Turgut Hamdi; "Endocrinologic studies of patients with interstitial keratitis: A preliminary report," Dr. Joseph V. Klauder, Dr. Benjamin A. Gross, and Dr. Harold A. Hanno; "Penetrating wounds of the globe, analysis of one-hundred consecutive cases," Dr. Carroll R. Mullen; "Nystagmus: Its diagnostic significance," Dr. Edmund B. Spaeth.

The Arthur J. Bedell Lecture was presented by Dr. Francis Heed Adler. His subject was "Factors determining the choice of operative procedures in squint."

Societies

Central Illinois meeting

The next meeting of the Central Illinois Society of Ophthalmology and Otolaryngology will be held at the Illinois Hotel, Bloomington, Illinois, on April 21st, 22nd, and 23rd. Dr. A. E. Braley, New York, will give several lectures on "Diseases of the eye." Dr. Louis Clerf, Philadelphia, will discuss "Laryngeal diseases." Dr. Louis Ostrom, Rock Island, Illinois, and Dr. H. Middleton, Alton, Illinois, will also give papers.

Georgia meeting

The Georgia Society of Ophthalmology and Otolaryngology held its annual meeting at the General Oglethorpe Hotel, Savannah, March 3rd and 4th. Among the guest lecturers in ophthalmology were: Dr. Meyer Wiener, Coronado, California, who spoke on "Medical and surgical ophthalmology"; Dr. Milton L. Berliner, New York, "Slitlamp microscopy"; Dr. Wendell L. Hughes, Hempstead, New York, "Lid reconstruction."

Officers of Cuban society

Officers of the Cuban Society of Ophthalmology elected to serve the two-year term, 1950 to 1952, are: President, Dr. Oscar F. Horstmann; first vice-president, Dr. Bernardo Duelo; second vice-president, Dr. J. Anaya Bestard; secretary, Dr. Heriberto Busch; vice secretary, Dr. José Alfonso, Jr.; treasurer, Dr. Guillermo de la Torre; and vice treasurer, Dr. Rolando Branly.

The society meets regularly the first Thursday of each month in the building of the medical college at Malecón 61, Havana.

de Schweinitz Lecture

The 13th annual de Schweinitz Lecture will be presented before the College of Physicians of Philadelphia, Section on Ophthalmology, on Thursday, November 16, 1950, by Dr. Parker Heath, Boston, Massachusetts.

Personals

Dr. Ronald Atmore Cox has been appointed professor of ophthalmology and executive officer of the Department of Ophthalmology, The George Washington University School of Medicine, Washington, D.C., to succeed Dr. Ernest A. W. Shepard, who has resigned to devote more time to research, although he will continue to teach in the school of medicine.

Dr. Alson E. Braley, professor and chairman of the Department of Ophthalmology at the Post-Graduate Medical School of New York University College of Medicine at the Bellevue Medical Center, has been appointed professor and chairman of the Department of Ophthalmology at the State University of Iowa College of Medicine, Iowa City, effective July 1, 1950. Dr. Braley succeeds Dr. Cecil S. O'Brien, retired, who was head of the Department of Ophthalmology at Iowa State for 24 years, since 1925.

Dr. Braley received his medical degree from the University of Iowa in 1931. From 1937 to 1939, he was instructor of ophthalmology there. In 1939, he became assistant professor in ophthalmology at Wayne University, Detroit. Two years later he became assistant attending ophthalmologist at the Columbia-Presbyterian Medical center, New York.

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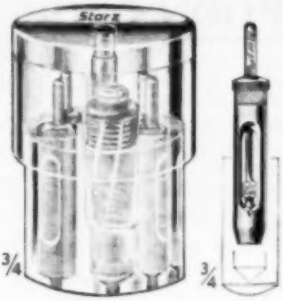

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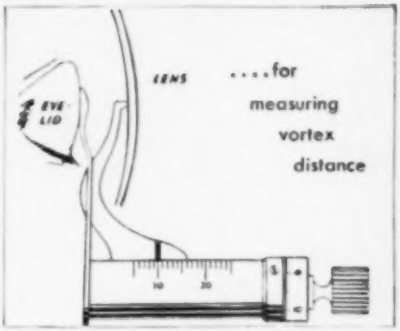

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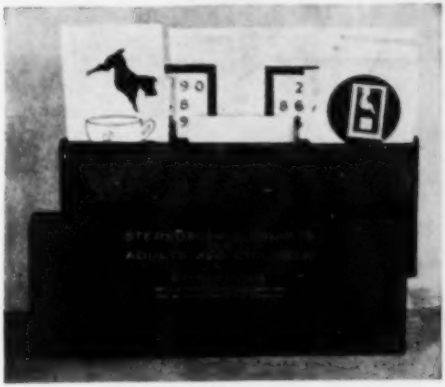

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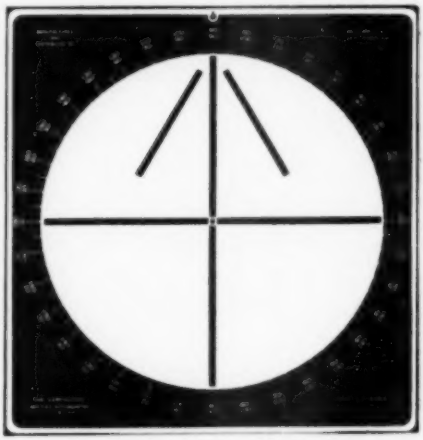

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